NUCLEAR SCIENCE ABSTRACTS

Volume 32 Number 1

Abstracts 1-2950

July 15, 1975

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of ERDA and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, ERDA's Technical Progress Reviews, ERDA-sponsored translations, conference proceedings published by ERDA, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of ERDA reports in countries other than the United States are listed on the inside back cover.

ALABAMA
- Auburn, Auburn University
- Tuskegee Institute, Tuskegee Institute

ARIZONA
- Tucson, University of Arizona

CALIFORNIA
- Davis, University of California
- Los Angeles, University of California
- Santa Barbara, University of California

COLORADO
- Boulder, University of Colorado

DISTRICT OF COLUMBIA
- Washington, Library of Congress

FLORIDA
- Gainesville, University of Florida

GEORGIA
- Atlanta, Georgia Institute of Technology

HAWAII
- Honolulu, University of Hawaii

IDAHO
- Pocatello, Idaho State University

ILLINOIS
- Urbana, University of Illinois

INDIANA
- Lafayette, Purdue University

IOWA
- Ames, Iowa State University

KANSAS
- Manhattan, Kansas State University

KENTUCKY
- Lexington, University of Kentucky

MARYLAND
- Baltimore, Johns Hopkins University
- College Park, University of Maryland

MASSACHUSETTS
- Cambridge, Massachusetts Institute of Technology
- Worcester, Worcester Polytechnic Institute

MICHIGAN
- Ann Arbor, University of Michigan

MISSISSIPPI
- State College, Mississippi State University

MISSOURI
- Columbia, University of Missouri
- Kansas City, Linda Hall Library

NEW JERSEY
- Princeton, Princeton University

NEW MEXICO
- Albuquerque, University of New Mexico

NEW YORK
- Albany, New York State Library
- Albany, State University at Albany
- Ithaca, Cornell University
- New York, Columbia University
- Rochester, University of Rochester
- Syracuse, Syracuse University

NORTH CAROLINA
- Raleigh, North Carolina State University

OHIO
- Cincinnati, University of Cincinnati
- Cleveland, Cleveland Public Library
- Toledo, University of Toledo

OKLAHOMA
- Norman, University of Oklahoma

PENNSYLVANIA
- Philadelphia, University of Pennsylvania
- Pittsburgh, Carnegie Library
- University Park, Pennsylvania State University

PUERTO RICO
- San Juan, University of Puerto Rico

SOUTH CAROLINA
- Columbia, University of South Carolina

TENNESSEE
- Knoxville, University of Tennessee

TEXAS
- Austin, University of Texas
- College Station, Texas A & M University
- Houston, Rice University

UTAH
- Salt Lake City, University of Utah

VIRGINIA
- Blacksburg, Virginia Polytechnic Institute
- Charlottesville, University of Virginia

WASHINGTON
- Pullman, Washington State University
- Seattle, University of Washington

WEST VIRGINIA
- Morgantown, West Virginia University

WISCONSIN
- Madison, University of Wisconsin

ERDA reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Volume 32, Number 1, July 15, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau – Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

NSA is issued in two volumes per calendar year, one beginning January 15, the other July 15. Each volume consists of twelve issues.

For the two 12-issue volumes, the annual subscription rate is $121.05 for domestic subscribers and $151.35 for foreign subscribers. A single issue costs $5.05 domestic rates or $6.26 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes are cumulated for each volume, i.e., on a six-month volume basis. If purchased on an annual subscription basis the two volume indexes are priced at $44.40 for domestic subscribers and $55.50 for foreign subscribers.

The volume indexes are also sold separately. Each volume index is priced on the basis of pagination at the time of publication.

Previous *NSA* cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.
Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.
Vol. 26, Subjects and Authors (1972), $37.75
Vol. 27, Subjects, Authors, and Report Numbers (Jan.–June 1973), $16.90.
Vol. 28, Subjects and Authors (July–Dec. 1973), $18.55.
Vol. 29, Subjects and Authors (Jan.–June 1974), $20.10.
Vol. 30, Subjects, Authors, and Report Numbers (Vols. 29 and 30) (July–Dec. 1974), $27.35.
Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–28, $9.35.

From Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106:

Vols. 21–25, Subjects, Authors, and Corporate Authors (1967–1971), $195.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.00.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

HOLLOWAY, J.A., Survey of image processing methods for radiography, 31:16451
HOLLWEG, J.V., Hydromagnetic waves in interplanetary space, 31:17953
HOLMBERG, E.B., Distribution of clusters of galaxies as related to galactic absorption, 31:16040
HOLMES, J.J., See BATES, J.F., 31:17444

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

NUCLEAR POWER PLANTS/REACTOR LICENSING
Experience acquired in the design and construction of operating plants (German Federal Republic), 31:19104
NUCLEAR POWER PLANTS/REACTOR SAFETY
Conception of radiation safety in atomic electric power plants, 31:16032 (CONF-701074-P1)
NUCLEAR POWER PLANTS/SITE SELECTION
Safety-related site parameters for nuclear power plants, 31:19052 (WASH-1361)
Status and development of nuclear power in the Federal Republic of Germany, 31:19105
NUCLEAR PROPERTIES/RESEARCH PROGRAMS
Accelerator physics group progress report, July--December 1973 (Research summaries), 31:18544 (INS-R-139)

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

17606 (ANL/HEP-7440, pp I.1-I.12) ACCELERATED POLARIZED PROTONS AT THE ZGS. Ratner, L. G. **(Argonne National Lab., IL).** Feb 1974.
From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).
In symposium on high-energy physics with polarized beams.

is indexed as:

ARGONNE NATIONAL LAB., ILL. (USA)
Accelerated polarized protons at the ZGS, 31:17606 (ANL/HEP-7440)
Acceleration of polarized protons in synchrotrons, 31:17692 (ANL/HEP-7440)
Analysis of population, birth, and death statistics in the counties surrounding the Big Rock Point Nuclear Power Station, Charlevoix County, Michigan, 31:16552 (ANL-8149)
Argonne polarized target facilities, 31:17762 (ANL/HEP-7440)
Calculation of transient fission-gas release from oxide fuels, 31:19031 (ANL-8143)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

WASH-		
1164	31:19025	Dep. NTIS, $16.00
1359	31:16524	Dep. NTIS, $10.60
1361	31:19052	Dep. NTIS, $3.75
WCAP-	**(Misc.)**	
7906	31:19053	Dep. NTIS, $5.50
XDC-		
60-3-68	31:18403	Dep. NTIS, $7.25
XN-	**(Non-ERDA)**	
74-21(Rev.1)	31:19054	
209(Suppl.4) (Rev.1)	31:18750	Exxon, Richland, WA
Y-		
1966	31:19188	Dep. NTIS, $4.00

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 32, Number 1, July 15, 1975

Category	Page
CHEMISTRY	1
Analytical and Separations Chemistry	1
Activation and Nuclear Reaction Procedures	1
Chemical and Spectral Procedures	2
Radiometric and Radiochemical Procedures	4
Separation Procedures	5
Inorganic, Organic, and Physical Chemistry	9
Chemical and Physicochemical Properties	10
Isotope Effects	10
Isotope Exchange and Isotope Separation	11
Feed Materials Processing	12
Radiation Chemistry	12
Radiochemistry and Nuclear Chemistry	16
Hot-Atom Chemistry	17
Properties of Radioactive Materials	17
Radioactive Waste Treatment	19
Radioisotope Production	20
Reactor Fuel Reprocessing	20
CONTROLLED THERMONUCLEAR RESEARCH	23
Plasma Confinement and Heating	23
Plasma Diagnostics	24
Plasma Kinetics (General)	26
Plasma Kinetics (Experimental)	27
Plasma Kinetics (Theoretical)	27
Plasma Production	29
Plasma Stability	30
Thermonuclear Engineering and Equipment	31
Wave Phenomena	34
ENGINEERING	36
Energy Conversion	36
Facilities and Equipment	37
Lasers	42
Cryogenic and Superconducting Equipment and Devices	49
Heat Transfer and Fluid Flow	56
Materials Testing	58
Nuclear Explosions	59
Protective Structures and Equipment	61
Safety Engineering	61
Vacuum Engineering	61
ENVIRONMENTAL AND EARTH SCIENCES	63
Minerals and Ores	63
Radioactive Effluents	71
Radioactivity Monitoring and Transport	71
Atmosphere	73
Soil	73
Water	73
Ecosystems and Food Cycles	74
Radiometric Techniques	74
Site Surveys	74
Thermal Effluents	75
Chemical Effluents	77
INSTRUMENTATION	78
Radiation Detection Instruments	78
General Detectors and Monitors	78
Radiation Dosimeters	86
Nuclear Spectroscopic Instrumentation	87
High Energy Physics Instrumentation	89
Radiometric Instruments	91
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	91
Miscellaneous Instruments	93
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	97
Isotope Separation (Industrial)	97
Isotopic Power Sources	98
Radiation Sources	99
Design and Fabrication	99
Industrial Uses	99
LIFE SCIENCES	101
Radiation Effects on Biochemicals	101
Radiation Effects on Cells	102
Radiation Effects on Microorganisms	103
Radiation Effects on Plants	106
Radiation Effects on Animals	109
Man	109
Vertebrates	114
Invertebrates	118
Radionuclide Effects (Internal Source)	119
Man	119
Animals	120
Nuclide Kinetics and Toxicology	120
Man	120
Animals	121
Plants	122
Microorganisms	123
New Tracer Techniques	123
MATERIALS	129
Ceramics and Cermets	129
Metals and Alloys	134
Corrosion and Erosion	135
Preparation and Fabrication	137
Properties, Structure, and Phase Studies	139
Radiation Effects	150
Other Materials	152
NUCLEAR MATERIALS AND WASTE MANAGEMENT	157
Accountability and Safeguards	157
Disposal and Storage	157
Handling Equipment and Procedures	158
Transportation	159

TABLE OF CONTENTS (continued)

Category	Page
PARTICLE ACCELERATORS	161
Design, Development, and Operation	161
Auxiliaries and Components	162
Ion Sources and Injection and Extraction Systems	164
Ion Optics and Field Calculations	164
Storage Rings	165
Experimental Facilities	165
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	168
Cosmic Radiation	168
Stars	169
Quasi-Stellar, Radio, and X-Ray Sources	172
Solar Phenomena	172
Galaxies	174
Cosmology	175
Planetary Phenomena	176
PHYSICS (ATMOSPHERIC)	177
Auroral and Ionospheric Phenomena	177
Magnetospheric Phenomena	178
PHYSICS (ATOMIC AND MOLECULAR)	181
Beams and Their Reactions	181
Atomic and Molecular Properties	181
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	182
Collision Phenomena	183
Atomic Theory	186
PHYSICS (HIGH-ENERGY)	188
Particle Interactions and Properties (Experimental)	188
Electromagnetic	188
Weak	188
Strong (Baryon-induced)	188
Strong (Meson-induced)	189
Particle Interactions and Properties (Theoretical)	189
General	189
Electromagnetic	189
Weak	190
Strong (General)	191
Strong (Baryon No. = 0)	192
Strong (Baryon No. = 1)	192
Strong (Baryon No. ≥ 2)	192
Particle Invariance Principles and Symmetries	192
General	192
Applications (Electromagnetic and Weak)	193
Applications (Strong)	193
Scattering Theory	193
PHYSICS (LOW-TEMPERATURE)	194
Superfluidity	194
Superconductivity	195
PHYSICS (NUCLEAR)	196
Neutron Interactions with Matter	196
Nuclear Properties and Reactions, A < 5	196
Nuclear Properties and Reactions, 6 < A < 19	197
Nuclear Properties and Reactions, 20 < A < 38	198
Nuclear Properties and Reactions, 39 < A < 58	200
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, 59 < A < 89	202
Nuclear Properties and Reactions, 90 < A < 149	203
Nuclear Properties and Reactions, 150 < A < 189	206
Nuclear Properties and Reactions, 190 < A < 219	207
Nuclear Properties and Reactions, A ≥ 220	207
Nuclear Theory	208
PHYSICS (RADIATION AND SHIELDING)	213
Radiation Physics	213
Radiation Protection Standards	213
Shielding Calculations and Experiments	213
PHYSICS (THEORETICAL)	214
General	214
Quantum Field Theories	214
Gravitation and General Relativity	215
REACTOR TECHNOLOGY AND REGULATION	217
Power Reactors, Non-Breeding, BWR-Type	217
Power Reactors, Non-Breeding, PWR-Type	219
Power Reactors, Non-Breeding, Graphite Moderated	221
Power Reactors, Non-Breeding, Otherwise Moderated	224
Power Reactors, Breeding	225
Research, Test, and Experimental Reactors	230
Production and Materials Testing and Processing Reactors	233
Propulsion and Package Reactors	233
Reactor Safety and Environmental Aspects	254
Reactor Theory and Calculation	261
Reactor Components and Accessories	262
Reactor Fuels	263
Reactor Control Systems	264
Nuclear Power Plant Economics	267
Reactor Fuel Cycle Economics	268
Reactor Licensing and Regulation	269
GENERAL AND MISCELLANEOUS	271
Civilian Defense	271
Information Handling	271
Law	271
Management	271
Mathematics and Computers	272
Chemistry	272
Life Sciences	272
Materials	272
Physics and Engineering	273
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-18
SUBJECT INDEX	INDEX-65
REPORT NUMBER INDEX	INDEX-193
SCOPE AND SECTION ARRANGEMENT	APPENDIX-1
JOURNAL LIST	APPENDIX-27

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
P. Martin Alexander
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Stanley D. Frey
Darrell O. Galde
Martha W. Gerrard
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Lorne T. Newman
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jessie W. Rushing
Robert W. Rutkowski
Francis L. Sachs
Lila B. Smith
Polly C. Summers
George H. Thoeming
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 32, Number 1 July 15, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 152, 647, 1552–1554, and 1556.

1 INORGANIC AND GEOLOGICAL MATERIALS. Dinnin, J. I. (Geological Survey, Reston, VA). Anal. Chem.; 47: No. 5, 112R-127R(Apr 1975).

Recently described methods for applied inorganic analysis are reviewed from an interdisciplinary standpoint. Abstracts and periodical literature up to Nov. 1974, are included for consideration. The following areas of interest are covered: general reviews of inorganic analytical techniques; analytical techniques, areas of application, and analysis of individual elements. Selected books, monographs, and review articles on the analytical chemistry of the elements are listed. (416 references.) (JGB)

2 FERROUS METALLURGY. Straub, W. A.; Jurwitz, J. K. (United States Steel Corp., Monroeville, PA). Anal. Chem.; 47: No. 5, 112R-127R(Apr 1975).

This review covers the period from November, 1972 through October, 1974, and is a continuation of previous reviews. Chemical Abstracts and Analytical Abstracts were searched. Analyses of steels by various methods, including neutron activation, and for various elements, including Be, Mo, Nb, rare earths, Te, U, and Zr are included. (563 references.) (JGB)

3 NONFERROUS METALLURGY-LIGHT METALS: ALUMINUM, BERYLLIUM, TITANIUM, AND MAGNESIUM. Seim, H. J.; Calkins, R. C.; Macksey, J. A. (Kaiser Aluminium and Chemical Corp., Pleasanton, CA). Anal. Chem.; 47: No. 5, 128R-139R(Apr 1975).

Literature on nonferrous metallurgical analysis published during the two-year period from September, 1972, through August, 1974, as documented by Chemical Abstracts, Analytical Abstracts, and Government Reports Announcements is reviewed. A few selected books and the following journals also were surveyed for the same period: Analytical Chemistry, Analytica Chimica Acta, The Analyst, Applied Spectroscopy, Talanta, and World Aluminum Abstracts. Methods of analysis for various elements, including Be, Nb, rare earths, Th, and Zr in nonferrous metallurgical materials are given. (234 references.) (JGB)

4 WATER ANALYSIS. Fishman, M. J.; Erdmann, D. E. (Geological Survey, Lakewood, CO). Anal. Chem.; 47: No. 5, 334-361(Apr 1975).

The literature of analytical chemistry applied to water analysis is reviewed for the period Oct. 1972, through Sept. 1974. The material used in preparing the review comes mainly from major analytical journals and Chemical Abstracts. Many methods, including activation and radiometric, are discussed for the analyses of various elements, including Mo, U, Th, rare earths, and halides. Radioactivity and isotope analysis are also discussed. (663 references.) (JGB)

5 NPDES PERMITS AND WATER ANALYSES. Pojasek, R. B. (QLM Labs., Inc., Nyack, NY). Environ. Sci. Technol.; 9: No. 4, 320-324(Apr 1975).

Provisions of the Federal Water Pollution Control Act, as amended by P. L. 92-500, including an explanation of the National Pollutant Discharge Elimination System (NPDES), and EPA's criteria for the analysis of pollutants are discussed. The need for a revision of current restrictive variance procedures is pointed out. References for the comparison of analytical methods for water pollutants under permits, including radioactive parameters, are tabulated. (JGB)

6 PETROLEUM. Fraser, J. M. (Union Oil Co. of California, Brea). Anal. Chem.; 47: No. 5, 169(Apr 1975).

This review covers papers abstracted in Chemical Abstracts, in the American Petroleum Institute Refining Literature Abstracts, and in Analytical Abstracts (London) for the period of July 1972 through June 1974. Section headings are: crude oils (including discussions on heterocompounds, shale oil, asphalts and residues, metals and salts, non-routine and routine characterizations, and distillation data; fuels, gaseous and liquid; lubricants, oils and greases; wax; asphalt; catalysts; physical properties; hydrocarbons, metals in oils; nonmetal elements and compounds; analytical and process instrumentation; specific compounds and type compounds; physical property methods; improved instrumentation and techniques; and pollution analysis and instrumentation. (1594 references) (JGB)

7 SOLID AND GASEOUS FUELS. Hattman, E. A.; Schultz, H.; Smith, J. F. (Pittsburgh Energy Research Center). Anal. Chem.; 47: No. 5, 85R-97R(Apr 1975).

Publications concerned with methods of sampling, analyzing, and testing solid mineral and gaseous hydrocarbon fuels are surveyed. The period covered extends from October 1972, through September 1974. Activation and radiometric methods are among those discussed for the analysis of coal, ash, and oil shale. Methods for the analysis of Be, Sc, and Te, among other elements, are discussed. (JGB)

Activation and Nuclear Reaction Procedures

Refer also to abstract 776.

8 (COO-3521-160) LOW DOSE HUMAN CALCIUM ASSAY IN VIVO VIA THE $^{40}Ca(n,alpha)$ REACTION. Bigler, R. E.; Laughlin, J. S.; Davis, R. Jr.; Evans, J. C. (Sloan-Kettering Inst. for Cancer Research, New York (USA); Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Contract AT(11-1)-3521. 12p. Dep. NTIS $4.00.

A compact medical cyclotron was investigated to elucidate its merit as a neutron source for both qualitative and quantitative activation analysis human studies in vivo of calcium and other elements within the human body and at reasonable radiation dose levels. Emphasis is given to those properties necessary for carrying out quantitative whole body calcium measurements using the $^{40}Ca(n,alpha)^{37}Ar$ reaction, which because of the low radiation dose and relatively modest equipment requirements, give this method potential for wide application in diagnostic studies of calcium metabolism. (auth)

9 (INIS-mf-1658) FEASIBILITY OF DETERMINING NEUTRON EXPOSURE BY MEASURING INDUCED ACTIVITY IN BIOLOGICAL MATERIALS. Solnicka, H.; Hahnova, V.; Havejova, L.; Kropackova, M. (Zavodni Ustav Narodniho Zdravi Uranoveho Prumyslu, Pribram (Czechoslovakia)). 1973. 73p. (In Czech). INIS.

The radioactivation of sulfur contained in hair and nails by the threshold reaction $^{32}S(n,p)^{32}P$ was studied experimentally. The content of sulfur, i.e., the target element of the reaction, and the content of phosphorus were determined in sets of hair and of nails to confirm that reaction $^{31}P(n,p)^{32}P$ contributes very little to the measured ^{32}P activity. It was found that the beta

activity in hair and nails could be measured directly, without previous chemical separation of ^{32}P. One hour's measurement of ^{32}P activity in 1 g of the hair sample may detect a neutron dose of 0.4 rad [neutrons exceeding the energy threshold of reaction $^{32}S(n,p)^{32}P$]. One hour's measurement of ^{32}P activity in 0.1 g of the nail sample may detect a neutron dose of ~6 rad. Some radionuclides were identified in hair and in nails from reactions induced in trace elements by thermal neutrons. (auth)

10 DETERMINATION OF ATMOSPHERIC POLLUTANTS BY ACTIVATION ANALYSIS. Miyamaru, M.; Lima, F. W. (Inst. Energia Atomica, Sao Paulo, Brazil). Rev. Brasil. Tecnol.; 4: No. 3-4, 133-140(1973). (In Portuguese).

The elements, collected on a Millipore filter after the passage of ≈40 cm^3 of air, were irradiated for ≈8 hr with a flux of ≈10^{12} neutrons per cm^2 per sec. Mercury, As, Sb, and Se were converted into their bromides by treatment with 40% HBr–HNO_3 (1 : 1) and these were dissolved in hot fuming H_2SO_4–30% aq. H_2O_2 (8 : 7). The four bromides and Br were separated by distillation and anion exchange and the elements were counted with use of a γ spectrometer and NaI(Tl) scintillator. In the distillation residue, Zn, Na, Sc, Fe, Cu, Sm, La, K, W and Cr could be identified by means of a Ge(Li) counter. (Anal. Abstr.)

11 DETERMINATION OF THE CONTENT OF MACRO- AND MICROELEMENTS IN FRAGMENTAL ROCKS FROM A REGOLITH SAMPLE FORM LUNA 16 BY NONDESTRUCTIVE ACTIVATION ANALYSIS. Tsimbalnikova, A.; Palivtsova, M.; Frana, I.; Mashtalka, A. (Inst. of Nuclear Physics, Rzhezh, Czech.). Geokhimiya; No. 2, 190-198(Feb 1975). (In Russian).

In 14 rock fragments from a regolith sample from Luna-16 (6 breccias, 7 agglomerates) by the method of nondestructive activation analysis the contents of the following macro- and microelements were determined: Si, Ti, Al, Cr, Fe, Mn, Mg, Ca, Na, K, Sc, V, Co, Ni, Zn, Br, Sr, Zr, Mo, In, Sn, Sb, Te, Ba, La, Ce, Sm, Eu, Dy, Yb, Lu, Ta, Hf, Au, Cs, W, Re, U. Results are discussed together with results of an earlier carried out analysis of 12 other rock fragments (3 microgabbro, 1 basalt, 4 breccia, 3 agglomerates, 1 slag) from lunar soil of "Luna-16" with the purpose of characterizing the chemically separate rock types from lunar soil of "Luna-16," to establish some differences between them and show possible dependences. (auth)

12 FISSILE ISOTOPE DETERMINATION IN IRRADIATED FUEL ELEMENTS AND WASTE SAMPLES USING Sb–Be NEUTRONS. Filiss, P. Trans. Amer. Nucl. Soc.; 20: 341-343(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

13 DETERMINATION OF PHOSPHORUS IN SILICATE ROCKS BY ACTIVATION ANALYSIS. Khalil, S. O. (Alexandria Univ., Egypt). Acta Chim. Acad. Sci. Hung.; 83: No. 3-4, 223-228(1974).

A neutron activation method for the determination of phosphorus as silver thallium(I) phosphate (Ag_2TlPO_4) from ammonium phosphomolybdate precipitate is applied to silicate rocks. Ammonium phosphate is added as carrier to the irradiated rock powder and the phosphorus recovered as ammonium phosphomolybdate, which is precipitated several times in the presence of appropriate holdback carriers to ensure its radiochemical purity and then finally dissolved and reprecipitated as silver thallium(I) phosphate (Ag_2TlPO_4) for weighing and counting. (auth)

14 NEUTRON-ACTIVATION DETERMINATION OF IRIDIUM IN LOW-GRADE COPPER-NICKEL ORES. Aleksandrov, St. (Sofia Univ.). Zh. Anal. Khim.; 30: No. 2, 322-325(Feb 1975). (In Russian).

A procedure was developed of neutron activation determination of iridium in low-grade copper-nickel ores at iridium contents of 10^{-4} to 10^{-7}%. Iridium and the accompanying elements Au, Ag, Pt, and Pd are separated from common metals by the fire assay method. Radiochemical separation of iridium from silver, gold, platinum, and palladium is carried out by a column packed with copper sulfide. Activity of the iridium isolated is measured by a 4000-channel γ-analyzer with a Ge(Li)-detector. (auth)

15 A METHOD OF UTILIZING LITHIUM-INDUCED NUCLEAR REACTIONS IN THE DETERMINATION OF CARBON, NITROGEN, AND OXYGEN IN THIN FILMS. Cardinal, C.; Brassard, C.; Chabbal, J.; Deschênes, L.; Labrie, J.P.; L'Ecuyer, J.L. (Laboratoire de Physique Nucléaire, Université de Montréal, Montréal, Canada); Leroux, M. Appl. Phys. Lett. 26: No. 9, 543-545 (1 May 1975).

A method of analysis of oxygen, nitrogen, and carbon in thin samples involves the detection of charged particles from nuclear reactions induced by a 7-MeV lithium-6 beam. The particle detection with a telescope counter near 0° takes full advantage of high exothermic reactions. The sensitivity is of the order of 10^{-3} $\mu g/cm^2$. A preliminary study of the contaminants introduced during the sputtering of niobium is presented. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 150, 660, 720, 936, and 961.

16 (BARC-750) SPECTROGRAPHIC ESTIMATION OF GALLIUM IN PLUTONIUM BY CARRIER DISTILLATION TECHNIQUE. Dhumwad, R. K.; Kulkarni, V. T.; Patwardhan, A. B. (Bhabha Atomic Research Centre, Bombay (India)). 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

A spectrographic method for the estimation of Ga in plutonium (in the range of 0.4 to 40 ppM) based on the carrier distillation technique is described. NaCl is used as a carrier with Sn as an internal standard. Plutonium oxide samples are analyzed by mixing with pure U_3O_8 in the ratio 1 : 3. The overall standard deviation of the method is 11% at 67% confidence level. (auth)

17 (CEA-CONF-2781) ENERGY DISPERSION QUANTITATIVE X RAY MICROANALYSIS ON A SCANNING ELECTRON MICROSCOPE. Servant, J. M.; Meny, L.; Champigny, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). [nd]. 7p. (CONF-740749-1). Dep. NTIS (US Sales Only) $4.00.

From 7th international conference on X-ray optics and microanalysis; Moscow-Kiev, USSR (9 Jul 1974).

In this work, quantitative measurements performed by EDX on S. E. M. and by WDX on EPMA are compared. The commercial SEM has been improved by adding a beam regulation and an anticontamination device. The spectra are detected by a Si(Li) detector (FWHM = 180 eV) and digitalized by an Analog to Digital converter. The obtained spectra are treated by an in-line minicomputer PDP 11/05 included in a N. S. 880 system. A terminal built-in magnetic tape cassette, which functions as a storage device for the computer. Binary alloys TiAl, FeAl, ZrNi, NbAl, TiZr have been studied by K and L lines, at different values of the excitation-voltage. Alloys MgAl, FeMn and TiVCr presenting overlapping peaks, and a glass, have also been analyzed. The errors, the advantages and limits of the method are discussed. In a homogeneous bulk material, the minimum detectable limit is of the order of 0.03 w/o with WDX and 0.2% with EDX for 100 seconds counting time. It could be improved by increasing the counting time, and by using better electronics. The precision of the results is comparable to that obtained by WDX. With EDX on SEM, the rapid and simultaneous quantitative microanalysis of all the elements of $11 \leq Z \leq 92$ can be performed with good precision. (LK)

18 (FRNC-TH–495) ANALYSIS OF ELEMENT TRACES BY CHARACTERISTIC X-RAY SPECTROSCOPY. Lecoq, P. (Grenoble-1 Univ., 38 (France)). 1973. vp. (In French). INIT.

Thesis.

The fundamental theory of the excitation of the characteristic x rays of an element by γ rays or charged-particle bombardment (theory developed by Merzbacher and Lewis in the framework of the Born approximation; Garcia model based on the impulse approximation) is given. The experimental set-up used is described: the computer programs employed are presented in group form. The system used is highly adaptable and equally suited to either on-line processing, or to studies at a later date. Two series of experiments on the analysis of mineral water and iron-chromium alloys are presented. (INIS)

19 SPECTROPHOTOMETRIC DETERMINATION FOR TRACE AMOUNT OF CHLORIDE IN URANIUM. Chu, C. F.; Wu, S. S. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). J. Chin. Chem. Soc. (Taiwan); 21: No. 4, 223-228(Dec 1974).

A simple quantitative method is developed for the determination of trace amount of chloride in uranium without preliminary separation. The reactions are realized by mixing the sample with saturated mercury thiocyanate alcohol solution and 0.325M ferric ion in 5.52M perchloric acid solution. The wavelength 465 mμ is used for the determination of chloride. The interference of uranium is negligible for uranium concentration less than 400 ppm. When uranium concentration ranges from 400 to 1.2×10^4 ppm, the interference can be calculated based on the constancy of molar absorptivity of uranium solution at wavelengths 465 mμ and 415 mμ, therefore, a correction can be made for the determination of chloride. Interferences of other factors were also investigated. (auth)

20 DETERMINATION OF MOLYBDENUM IN STEELS AND ALLOYS BY TITRATION WITH FERROCENE. Yakovlev, P. Ya.; Solomatin, V. T.; Bakalova, L. M. (Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 9, 1245-1246(Sep 1974).

Translated from Zavod. Lab.; 40: No. 9, 1046-1048(Sep 1974).

The use of ferrocene for the oxidation-reduction potentiometric titration of Mo(VI) in the presence of organic solvents and inorganic acids was studied. The effects of the acidity of the solution, the character of the organic solvent, and the anion of the acid on the potential jump were determined. The highest values were obtained in a mixture of acetic (formic) and hydrochloric acids. Interferring elements were found to be V and Re. Procedures for the determination of Mo in Mo–W alloys, ferromolybdenum, and high-alloy steel were given. Data were reported on the reproducibility and accuracy of the titration. (JSR)

21 METHOD OF REMOVING THE SELECTIVE-EXCITATION EFFECT DURING X-RAY SPECTRAL FLUORESCENT ANALYSIS. Pavlinskii, G. V.; Kitov, B. I.; Losev, N. F. (Irkutsk State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 9, 1294-1298(Sep 1974).

Translated from Zavod. Lab.; 40: No. 9, 1083-1087(Sep 1974).

Relations between the spectral composition of the primary radiation and the angle of fluorescence were derived which makes it possible to determine a compensation angle for the x-ray fluorescence analysis of materials with an interferring element. Compensation angles were determined for materials containing Y and Mo or Zr and Nb and experimentally confirmed. (JSR)

22 SPECTROCHEMICAL METHOD OF DETERMINING NOBLE METALS IN WASTE SOLUTIONS (EXCHANGE OF EXPERIENCE). Shakurova, M. S.; Litvinskaya, I. I.; Kashlinskaya, S. E.; Karpova, A. F. Ind. Lab. (USSR) (Engl. Transl.); 40: No. 9, 1301-1302(Sep 1974).

Translated from Zavod. Lab.; 40: No. 9, 1088-1089(Sep 1974).

A spectrochemical method for the determination of Pd, Pt, Rh, Ru, Ir, and Au in waste solutions based on the sorption of the metals on "Mtilon-T" thiomid fiber was developed. The results of the spectrochemical determination were compared with spectral assay methods. The reproducibility of the spectrochemical method was ~20%. The detailed analytical procedure was outlined. (JSR)

23 FERTILIZERS. Gehrke, C. W.; Rexroad, P. R. (Univ. of Missouri, Columbia). Anal. Chem.; 47: No. 5, 42R-55R(Apr 1975).

This review covers the literature reported from January 1, 1973 to December 31, 1974, and includes procedures recorded in readily available journals, in Chemical Abstracts, and in Fertilizer Abstracts. Some selectivity was exercised in order to include only those procedures especially pertinent for direct application to fertilizers, easily adapted to fertilizers, or containing information related to research in fertilizer methodology. Methods are discussed for the determination of N, K, P, secondary nutrients, and micronutrients, including Mn, Mo, Na, B, Cl, Fe, Cu, Zn, and Co. (204 references.) (JGB)

24 ENTHALPIMETRIC DETERMINATION OF TRACES OF MOLYBDENUM(VI) AND TUNGSTEN(VI) BY A CATALYTIC-KINETIC METHOD. Feys, R.; Devynck, J.; Tremillon, B. (Ecole Nationale Superieure de Chimie, Paris). Talanta; 22: No. 1, 17-26(Jan 1975). (In French).

A kinetic method of determining molybdenum(VI) and tungsten(VI) is described. The elements act as catalysts of the oxidation reaction of iodide ions, thiosulfate ions, or rubeanic acid by hydrogen peroxide. The reaction rate is measured by an enthalpimetric method. The limit of sensitivity (about 0.02 mg/L) is compared with that of other experimental techniques generally used in kinetic analysis and interferences are examined. (auth)

25 SPECTROPHOTOMETRIC AND FLUOROMETRIC DETERMINATION OF TRACES OF MOLYBDENUM IN SOILS AND PLANTS. Haddad, P. R.; Alexander, P. W.; Smythe, L. E. (New South Wales Univ., Kensington, Australia). Talanta; 22: No. 1, 61-69(Jan 1975).

The reaction of the molybdenum oxypentathiocyanate ion with the dyestuff Rhodamine B (RhB) produces the ternary complex $MoO(SCN)_5(RhB)_2$. The formation of this complex is accompanied by a color change and by extinction of the fluorescence of RhB. A spectrophotometric and fluorometric method for the determination of Mo was developed from these observations. The method is free from interferences and has detection limits of 0.1 μg and 0.05 μg of Mo for absorption and fluorescence measurements, respectively. The spectrophotometric method is applicable to the determination of Mo in soils and the fluorometric method is suited to the determination of Mo in plants. (auth)

26 TITRIMETRIC DETERMINATION OF BERYLLIUM BY USING THE TARTRATE–FLUORIDE PROCEDURE. Bell, N. A. (Sheffield Polytechnic, Eng.). Analyst; 100: No. 1187, 124-128(Feb 1975).

The tartrate-fluoride titrimetric method for the determination of beryllium has been re-investigated, and a modified procedure has been developed to allow the determination of beryllium in the presence of other metal ions. The method is stoichiometric, rapid, and precise and is applicable to amounts of beryllium from 0.1 to 16 mg. The effects of diverse ions were investigated and many interferences were eliminated with EDTA. (auth)

27 DETERMINATION OF VANADIUM(V), CHROMIUM(VI) AND CERIUM(IV) IN BINARY OR TERNARY MIXTURE. Sriraman, K. (Andhra Univ. Post-Graduate Centre, Guntur, India). Talanta; 22: No. 1, 105-106(Jan 1975).

Potentiometric titration with iron(II) differentiates vanadium(V) and cerium(IV) but not vanadium(V) and chromium(VI), or chromium(VI) and cerium(IV) when present together. The methods available for the determination of these species in binary or ternary mixture are generally cumbersome and less accurate. A different scheme is proposed for this determination, based on the following considerations: vanadium(IV) can be titrated with cerium(IV) sulfate at room temperature, using ferroin indicator, even in the presence of chromium(III). Chromium(VI) is reduced completely by vanadium(IV) in a short time if the latter is used in excess. Although it seems that arsenic(III) selectively reduced chromium(VI) when added in excess to a solution containing chromium(VI) and cerium(IV) in dilute sulfuric acid, it is not possible to titrate the latter oxidant with iron(II) without interference from arsenic(III), when ferroin is used as indicator. At the concentrations used, arsenic(III) and cerium(IV) are not without reaction as is generally assumed, and the reaction is catalyzed by chromium(III) formed from the reaction of chromium(VI) and arsenic(III). It is even possible to determine arsenic(III) through a reaction between arsenic(III) and cerium(IV) catalyzed by chromium(III) at room temperature and the results are correct to within ±0.2%. The procedure is given. (auth)

28 COMPARATIVE ESTIMATION OF ERRORS OF ANALYTICAL TECHNIQUES. Lontsikh, S. V.; Berkovits, L. A. (All-Union Scientific-Research Inst. of Physico-Engineering and Radio-Engineering Measurements, Irkutsk, USSR). Zh. Anal. Khim.; 30: No. 2, 213-217(Feb 1975). (In Russian).

A method is considered of estimating cumulative analytical error, which involves errors in precision and accuracy of the measurements as components. The method was used to compare metrologic characteristics and to select procedures of determining tantalum in rare metal ores and concentrates. (auth)

29 USE OF MICROSOUND–FLAME–ADAPTER ATOMIZER IN ATOMIC-ABSORPTION DETERMINATION OF SMALL AMOUNTS OF ELEMENTS. Prudnikov, E. D. (Leningrad State Univ.). Zh. Anal. Khim.; 30: No. 2, 232-237(Feb 1975). (In Russian).

Design characteristics, sensitivity, accuracy, and various factors of analysis with a microsound–flame–adapter atomizer were examined. The sensitivity of atomic-absorption measurements with this atomizer was not worse than that obtained by using a graphite tube of equal diameter. When an acetylene–air flame and an adapter 3 to 10 mm in diameter and heated to 1000°C are used, the sensitivity equals 10^{-9} to 10^{-13} g for Cd, Zn, Ag, Pb, Bi, Cu, Hg, Se, Te, As, Sb, Sn, Au, Pt, Pd, Rh, and Fe. The atomizer can be used for determining microamounts of elements in microanalysis of various materials. The detection limits are 10^{-5} to 10^{-7}% when 0.1 to 1.0 mg samples are used. (auth)

30 REACTION BETWEEN LANTHANUM AND ARSENAZO III IN THE PRESENCE OF IRON, COPPER, COBALT, AND MOLYBDENUM IONS. Spitsyn, P. K.; Surin, I. G. Zh. Anal. Khim.; 30: No. 2, 284-287(Feb 1975). (In Russian).

Reaction between lanthanum and arsenazo III was studied spectrophotometrically in the presence of Fe, Cu, Co, and Mo. Ascorbic acid and thiourea solutions were used to mask steel components. The complex formation with lanthanum, absorption spectra and complex stability were studied in the presence of steel components. The complex of lanthanum with arsenazo III was stable for about 30 min under concentration conditions studied. A procedure was developed for direct determination of lanthanum in steel alloyed with Cu, Co, Nb, and Mo. The relative error is not more than 10% when $n \cdot 10^{-2}$% La is determined and not more than 2% in determining $n \cdot 10^{-1}$% La. (auth)

31 DETERMINATION OF ZIRCONIUM AND HAFNIUM BY SPECTROPHOTOMETRIC TITRATION IN MIXED SOLVENTS MEDIA USING REAGENT NITCHROMAZO. Kreshkov, A. P.; Kuznetsov, V. V.; Mezhlumyan, P. G. (Moscow Chemicotech-

nological Inst.). Zh. Anal. Khim.; 30: No. 2, 288-292(Feb 1975). (In Russian).

The reaction between barium and zirconium or hafnium fluoride complexes was examined in mixed solvents. The reaction proceeds to form ion pairs Ba_2MeF_8. Procedures were developed of spectrophotometric titration of zirconium and hafnium by using nitchromazo as indicator. The procedures make it possible to determine 1 to 60 μg Zr/ml and 1 to 180 μg Hf/ml in the presence of Th, U, Mo, W, Ge, rare earths without their separation. The procedures also permit determination of zirconium and hafnium mixtures. (auth)

32 EFFECT OF SOME METALS ON ELECTROOXIDATION OF TELLURIUM BY USING INVERSION VOLTAMMETRY. Figelson, Yu. A.; Neiman, E. Ya.; Yakovleva, V. G. (Moscow Inst. of Steel and Alloys). Zh. Anal. Khim.; 30: No. 2, 300-305(Feb 1975). (In Russian).

Using inversion voltammetry, effect of simultaneous electrodeposition of tellurium with copper, cadmium, mercury, and silver was examined on maximum current of tellurium electrooxidation. It was shown that during simultaneous electrodeposition these metals form compounds with tellurium electrooxidation currents of which can be used to determine tellurium by the IV method with better sensitivity than from currents of dissolution of its individual deposits. (auth)

33 SEPARATION AND GRAVIMETRIC DETERMINATION OF CERIUM AND LANTHANUM WITH N-M-TOLYL-M-NITROBENZOHYDROXAMIC ACID. Kapoor, H. L.; Agrawal, Y. K.; Verma, P. C. (Maulana Azad Coll. of Tech., Bhopal, India). Talanta; 22: No. 2, 193-196(Feb 1975).

Cerium and lanthanum were determined gravimetrically by selective precipitation with N-m-tolyl-m-nitrobenzohydroxamic acid and separated from several metal ions such as Ag^{+}, Be^{2+}, Pb^{2+}, Mn^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Hg^{2+}, Pd^{2+}, Ga^{3+}, Al^{3+}, Bi^{3+}, Sb^{3+}, Sn^{4+}, Ce^{3+}, Pr^{3+}, Nd^{3+}, Ti^{4+}, Zr^{4+}, Th^{4+}, V^{5+}, Mo^{6+} and U^{6+}. The precipitates were weighed directly after drying at 110°. The analytical results indicated the composition of the complexes to be $(C_{14}H_{11}N_2O_4)_nM$. (auth)

34 NEW TECHNIQUE OF ATOMIC-ABSORPTION ANALYSIS OF SOLIDS BY USING GRAPHITE CAPSULE–FLAME ATOMIZER. Katskov, D. A.; Kruglikova, L. R.; L'vov, B. V. (State Inst. of Applied Chemistry, Leningrad). Zh. Anal. Khim.; 30: No. 2, 238-243(Feb 1975). (In Russian).

A technique was developed of atomic-absorption analysis of solids with a graphite capsule–flame atomizer. The technique makes it possible to determine readily, moderately, and difficult, volatile elements in powders and fine-crystalline materials over a wide concentration range including trace levels. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 771, 873, and 911.

35 (AD-783032) X-RAY METHOD FOR THE DETERMINATION OF MOLYBDENUM IN LUBRICANTS. Phase Report. Lutz, D. A. (Naval Air Development Center, Warminster, Pa. (USA). Air Vehicle Technology Dept.). 19 Jul 1974. 10p. (NADC-74071-30). NTIS $3.00.

An x-ray fluorescence method for the determination of molybdenum in lubricants was developed. This method is nondestructive, involves minimum sample preparation, and compares in precision with wet chemical methods. The method yields percent of molybdenum as a function of the second order of k_{α} c (1,2) molybdenum x-ray emission line above background. (auth)

36 (IPNO-RI-74-1) REALIZATION OF AN AUTOMATIC RADIOPOLAROGRAPH AND APPLICATION TO CARRIER FREE ELEMENT STUDIES. Rogelet, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). 1974. 81p. (In French). INIS.

Radiopolarography allows a study of M(n) + ne – M(0) reactions, by substituting radioactivity measurement of the amalgamated elements at the d.m.e. for the measurement of the diffusion current intensity. Basic equations of classical polarography were transposed and tested with carrier-free manganese and europium. Using the automatic system built in the laboratory, the experimental points were reproducible about 3% and residual activity before the wave 3 ± 2% was compared with diffusion activity A_d. Results with manganese, for 80% of experiments, in $10^{-3} <= [LiCl] <= 10^{-1}$ and $2 <= pH <= 4$ solutions, gave an experimental yield $R = A_{dex}/A_d = 92 \pm 8\%$, $E_{\frac{1}{2}} = -1,47V/ECS$ and α approximately equal to 0,85. The last values agreed with results achieved at weighable scale. For potentials $<-2,00V/ECS$ a screen-effect influence on diffusion coefficient is taken into consideration and results for europium (R approximately equal to 95%, $E_{\frac{1}{2}}$ approximately equal to $-1,95V/ECS$, $\alpha = 1$ at $pH = 2,8$) were in good agreement with literature. Radiopolarograms for Mn and Eu and mixtures of both were similar. (FR)

37 (PB-223499) ANALYSIS OF TRITIUM OXIDE FROM SELECTED AREAS OF THE CONNECTICUT RIVER. Completion Report. Skauen, D. M. (Connecticut Univ., Storrs (USA). Inst. of Water Resources). 13 Apr 1973. Contract DI-14-31-0001-3507. 9p. NTIS $2.75.

Various techniques for the estimation of low-level tritium oxide are considered. A method based on liquid scintillation spectroscopy was selected as the most useful for routine analysis. All instrument and sample preparation parameters were studied experimentally for their applicability to the type of samples to be analyzed. The analytical technique thus developed was used to determine the tritium oxide in a variety of water samples including winter and spring samples from the Connecticut River in 1973. (auth)

38 (PB-237907) RADIOCHEMICAL ANALYSIS FOR Pb-210 AND Po-210 IN ENVIRONMENTAL SAMPLES. Technical Completion Report. Maestas, S.; Gallegos, A. E. (New Mexico State Univ., University Park (USA)). 1974. 65p. (WRRI-048; W-75-01858). NTIS $4.25.

An attempt was made to develop a comprehensive understanding of the content, distribution, and origin of lead in surface and ground waters in the general area of northeastern New Mexico and specifically in the northern regions of the Sangre de Cristo Mountains and the Pecos Wilderness. This portion of the study deals with the radiochemical isolation of RaD and RaF in water and biological samples and with the analysis of these radioisotopes in the samples mentioned. (GRA)

39 (RME-139) METHOD FOR MAKING GAMMA-ONLY LABORATORY ASSAYS SPECTRALLY EQUIVALENT TO GAMMA-RAY LOG MEASUREMENTS. Scott, J. H. (USAEC Grand Junction Office, Colo.). Dec 1961. 18p. GJO.

Laboratory gamma-only assays of uranium ore samples are used in conjunction with chemical assays of the same samples to determine the disequilibrium correction factor which is applied to gamma log measurements of natural uranium ore in situ. When laboratory gamma-only assays are made, the response of equipment should be adjusted so that the measurements are spectrally equivalent to those made in the field with the logging equipment. This can be accomplished by the following method. With the logging detector (crystal-photomultiplier or Geiger tube) temporarily substituted in place of the laboratory gamma-only detector, gamma-ray measurements are made of a sample containing only uranium-group isotopes and of another sample containing all isotopes in the uranium series. Various thicknesses of attenuating material are placed between source and detector when the measurements are made. The measurements provide data for a mathematical model, which is used to determine the fractional response of field logging equipment to uranium-group isotopes in a natural orebody. Similar measurements are made using the laboratory gamma-only detector to determine its fractional response to uranium-group isotopes in a standard sample. If necessary, the response of the laboratory equipment can be matched to that of the logging equipment by changing the thickness of attenuating material between the sample and detector or by changing the type of detector. Formulas are developed for calculating errors resulting from imperfectly matched laboratory and field equipment. (auth)

40 X-RAY RADIOMETRIC ANALYZER TO DETERMINE CHLORINE, CALCIUM, AND SULFUR CONCENTRATIONS IN SALINE SOILS. Gerling, V. E.; Zgardovskii, V. I. Geofiz. App.; No. 53, 86-90(1973). (In Russian).

This article deals with an investigation of the possibility of using x-ray radiometric analysis to determine the content of chlorine, calcium, and sulfur in soil samples and aqueous soil leachings. The threshold sensitivities with differential filters were found to be 0.02% for sulfur and 0.009% for chlorine at a measurement time of 200 seconds. (tr-auth)

41 DETERMINATION OF POTASSIUM IN SOLID SAMPLES BY MEASURING THE BETA FROM POTASSIUM-40. Sahara, R.; Iwasaki, B.; Sato, Y.; Takeuchi, M.; Endo, S. (Akita Univ., Japan). Akita Daigaku Kozangakubu Chika Shigen Kenkyushisetsu; No. 41, 25-31(Dec 1972). (In Japanese).

Measurements were made with both a Geiger counter and a gas-flow proportional counter. The counting rate was precise in powdered samples thicker than infinite thickness. The infinite thickness of 100% KCl was 0.34 g/cm² in the Geiger, while it is 0.20 g/cm² in the gas-flow counter. In the Geiger, such hygroscopic substances as KF and K_2CO_3 were unsuitable as

the standard substance for this determination. In the gas-flow counter such substances as KF, K_2CO_3, K_2SO_4 and KCl-$Fe(NH_4)(SO_4)_2$ mixtures produced a continuous discharge in the proportional region, but the radioactivity of these samples covered with a mica plate or vinyl sheet can be counted normally. Nonradioactive coexisting substances do not seem to interfere with this determination while the radioactive ones such as more than 0.2% Rb, more than 0.001% U, and more than 0.002% Th, interfere with this determination by the gas-flow and more than 0.5% Rb interferes with that by the Geiger. The interference by Rb could be removed absorbing the β ray from ^{87}Rb with an aluminium plate with a sufficient thickness. The results of this radiochemical determination in synthetic KCl-RbCl mixtures using an aluminium plate agreed with the prepared values within the experimental errors, while the result of flame-photometric measurement of a rock sample agreed with the radiochemical values obtained either by using the aluminium plate or by using no plate within the experimental errors. The method using no aluminium plate can determine more than 1% K in solid samples except pegmatite mineral etc., simply and rapidly. The limit of error is smaller than ±0.5%. The gas-flow has an advantage because it can detect α-ray from α-emitter and thus the accuracy of the analytical results is higher. Furthermore since it is sensitive, the counting time can be shortened. (auth)

42 CONTINUOUS DETERMINATION OF SULPHUR AND DENSITY OF MINERAL OILS INDEPENDENT OF THEIR C/H-RATIO. Trost, A. (Laboratorium Prof. Dr. Berthold, Wildbad (F. R. Germany)). Erdoel Kohle, Erdgas, Petrochem.; 27: No. 8, 431-434(Aug 1974). (In German).

Continuous sulfur analyzers with density compensation using low-energy γ-radiation (T) for sulfur determination and high-energy γ radiation (^{137}Cs) for the measurement of density have stood the test in their practical application. While analyzing different oils, the C/H-dependency amounting to 0.01% S per %-change of the C/H-ratio can be significant. This influence of the C/H-ratio on the sulfur value can, however, be compensated by a continuous measurement of the hydrogen content by means of a neutron probe in such a way that an accuracy of ±0.01% S for sulphur and ±1 g/dm^3 for density can be achieved independent of the C/H-ratio. (auth)

43 COMBINED SOLVENT EXTRACTION-LIQUID SCINTILLATION METHODS FOR RADIOASSAY OF ALPHA EMITTERS. McDowell, W. J.; Coleman, C. F. (Oak Ridge National Lab., TN). pp 2123-2135 of Solvent Extraction. London; Society of Chemical Industry (1974).

From International Solvent Extraction Conference; Lyon, France (8 Sep 1974).

Alpha-emitting nuclides frequently can be separated from one another and from interfering ions by solvent extraction procedures. If the last step of such a scheme automatically incorporates the nuclide of interest in a liquid scintillator (containing an extractant), a simple procedure for radioassay of the nuclide results. It is shown that correct choices of scintillators and detector systems produce further advantages. Quenching is minimized and held constant, so that the pulse height obtained from a given alpha energy is reproducible, and the energy resolution is improved over that obtainable with conventional liquid scintillation methods, so that alpha peak widths are decreased from around 1 MeV to 0.2 or 0.3 MeV at half maximum, Compatibility of several extractants with scintillator solutions is described. Procedures are described for separation and analysis of several nuclide, (e.g., plutonium, uranium, and trivalent actinides), including a specific application to the assay of plutonium in environmental samples. (auth)

44 DETERMINATION OF ^{147}Pm IN URINE AND FAECAL SAMPLES. Brown, D. A. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Ann. Occup. Hyg.; 17: No. 3-4, 197-204(Feb 1974).

A procedure for the determination of ^{147}Pm in urine and faces is described, based on surface adsorption on glass fiber filter paper followed by coprecipitation with a ferriphosphate complex. The complex was suspended in liquid scintillator by a gelling agent and ^{147}Pm counted in a liquid scintillation spectrometer at optimum instrument settings. The counting efficiency was 61%. The radiochemical recovery from urine was 87% and from faecal samples 91%. The minimum detectable level of ^{147}Pm in urine was 1 pCi/24 hr sample, and the corresponding level in feces was 10 pCi/sample. (auth)

45 THE PREPARATION OF SAMPLES FOR LIQUID SCINTILLATION DETERMINATION. Desplanche, J. (Packard, 94 - Rungis (France)). Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 161-174(Oct 1974). (In French).

From meeting on scintillation; Marseille, France (15 Feb 1974).

Stock is taken of the various samples for liquid scintillation determination most usually encountered in laboratories. They are divided into two main categories; the nonsoluble samples and the soluble ones. When it is impossible or very difficult to dissolve the labelled substance in the scintillating medium, a heterogeneous sample is prepared. There are three categories: the emulsions, the suspensions, and the samples deposited on a solid substrate. The directly soluble samples or those that can be placed in solution by employing intermediate substances lead to the counting of homogeneous samples. There are two categories: water and aqueous solutions, and the sample of animal or plant tissue. (FR)

Separation Procedures

46 (CEA-CONF-2902) METALS EXTRACTION BY α AND β-MONOSUBSTITUTED TETRAHYDROFURANS IN CHLORHYDRIC MEDIUM. Laurence, G. J.; Thai, T. L.; Bourguignon, J. R.; Michel, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. 21p. (CONF-740917-9). Dep. NTIS (US Sales Only) $4.25.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The preparations, main properties, and conditions of use of α- and β-monosubstituted tetrahydrofurans for solvent extraction processes are given. Derivatives of tetrahydrofuran are used in their pure state, and placed in contact with aqueous chloride solutions with an acid normality less than or equal to 6. Studies dealing with the extraction of a certain number of metal chlorides (Ga, Sn, Fe, Hg, Zn, Cd) show the influence of the structure of the organic solvents on their extractive properties. Results of extractions of iron(III) and gallium(III) by various tetrahydrofuran derivatives are compared to those obtained using linear ethers. (auth)

47 (PB-234512) OPERATION RED DOG. A Study of Fluid-Bed Combustion and Potential Uses of Anthracite Culm-Bank Material. Final Report, August 1966-April 1969. (Dorr-Oliver, Inc., Stamford, Conn. (USA)). Jul 1969. Contract DI-14-01-0001-492. 127p. (OCR-42). NTIS $9.50.

Results of a study to determine the economic potential of anthracite refuse, calcined in a fluid-bed reactor, are given. Recovery of germanium, lithium, vanadium, uranium, and alumina are covered along with sulfur dioxide and carbon dioxide recoveries from fluid-bed reactor stack gases. The finely ground reactor product could be used in a flyash brick process to produce a satisfactory clay-brick substitute; however, the brick was deemed not economically competitive in today's (1969) market. (GRA)

48 (RFP-2347) CATION EXCHANGE PROCESS FOR MOLTEN SALT EXTRACTION RESIDUES. Proctor, S. G. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 10 Mar 1975. Contract AT(29-1)-1106. 6p. Dep. NTIS $4.00.

A new method, utilizing a cation exchange technique, has been developed for processing molten salt extraction (MSE) chloride salt residues. The developed ion exchange procedure has been used to separate americium and plutonium from gross quantities of magnesium, potassium, and sodium chloride that are present in the residues. The recovered plutonium and americium contained only 20 percent of the original amounts of magnesium, potassium, and sodium and were completely free of any detectable amounts of chloride impurity. (auth)

49 SEPARATION OF NIOBIUM AND TANTALUM BY SOLVENT EXTRACTION WITH TERTIARY AMINES FROM SULPHURIC ACID SOLUTIONS. Markland, S. A. (Danish Atomic Energy Commission, Risoe). pp 2185-2196 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A new solvent extraction system for the separation of niobium and tantalum was developed based on extraction by tertiary amines from sulfuric acid solutions containing hydrogen peroxide and only stoichiometric amounts of fluoride. Separation factors of the order of several hundred were found. Metal complexes of the form $TaO(H_2O_2)F_4^-$ and $NbO(H_2O_2)F_4^-$ appear to be the extractable species involved. (auth)

50 STATE OF NIOBIUM WHEN EXTRACTED FROM SOLUTIONS OF SULPHURIC AND HYDROCHLORIC ACIDS. Frolov, Y. G.; Morgunov, A. F.; Soldatenkova, N. A. (Chemical-Technical Inst., Moscow). pp 2197-2208 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The state of niobium in organic extracts (diisoamyl methylphosphonate and TBP) and in solutions of sulfuric and hydrochloric

acids in equilibrium with them is investigated. In solutions in the course of time a state of equilibrium is established between extractable monomeric and highly associated nonextractable forms of niobium. It was found that there exists a quantitative dependence of the concentration of the monomeric form on the composition of an aqueous solution. The extraction from solutions of of sulphuric acid is shown by means of extracting, electrometric and spectroscopic methods and with the help of chemical analysis to be accounted for by the formation of solvated complex acids $H[NbO(OH)_2SO_4]$ and from solutions of hydrochloric acid by the formation of $H[NbO(OH)Cl_3]$ and $H[NbOCl_4]$. (auth)

51 EFFECT OF THE POLYMERIZATION OF ZIRCONIUM AND HAFNIUM ON THEIR EXTRACTION BY DIFFERENT CLASSES OF ORGANIC COMPOUNDS. Yagodin, G. A.; Sinefribova, O. A.; Chekmarev, A. M. (Chemical-Technical Inst., Moscow). pp 2209-2233 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Both monomer and polynuclear compounds of zirconium and hafnium are extracted by certain organic solvents. The nature of the extracted species depends on the nature of the extractant and the polynuclear compound formed. Under certain conditions, stable polynuclear compounds of zirconium and hafnium are formed and these are very stable under extremely severe conditions (high acid concentration, heating). When polynuclear compounds are extracted into the organic phase, the zirconium and hafnium separation factor decreases. (auth)

52 ECONOMICS OF SX AND ITS ALTERNATIVES FOR URANIUM AND COPPER. Dasher, J. (Bechtel Corp., San Francisco). pp 2817-2835 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

When uranium mill construction ceased about 1962, SX(Solvent eXtraction) was indicated for uranium, either alone in new plants or helping IX(resin Ion eXchange) in older plants. During the next decade IX became cheaper via new resins and new equipment, and SX showed it can save refining costs. The selective carbonate leach still has its place. For copper, SX is being economically applied to dump, heap, and agitation leach solutions (acid and ammoniacal) to get copper from waste rock, oxide ores, scrap and sulfide concentrates for electrowinning, but copper is also obtained economically from these materials without benefit of SX. (auth)

53 TRANSFER OF METAL NITRATES BETWEEN AQUEOUS NITRATE MEDIA AND NEUTRAL ORGANOPHOSPHORUS EXTRACTANTS. Farbu, L.; McKay, H. A. C.; Wain, A. G. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 2427-2436 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The rate of transfer of uranyl nitrate between an aqueous continuum and rising droplets of tri-n-butyl phosphate (TBP) or tri-n-octyl phosphine oxide (TOPO) in Odourless Kerosene (OK) was determined. Results have also been obtained for yttrium nitrate and TOPO/OK. All solutes were at low concentrations. All the transfer rates measured were found to be of first order in the metal concentrations. In the uranyl nitrate/TBP case, the continuum → drops rate constant (k') varied as $[TBP]^2$, while the drops → continuum rate constant (k) was independent of [TBP]. The rate-determining step therefore involves formation or breakup of $UO_2(NO_3)_2.2TBP$. In the uranyl nitrate/TOPO case there is a more complicated state of affairs, with k' varying relatively slowly with [TOPO], and k also depending on [TOPO]; it is suggested that the transfer is diffusion-controlled. In the yttrium nitrate/TOPO case the few results obtained suggest an intermediate state of affairs. (auth)

54 IONIC SPECIES OF Pa(IV) IN AQUEOUS PERCHLORATE SOLUTIONS. Lundqvist, R. (Chalmers Tekniska Hoegskola, Goteborg). pp 469-476 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Tetravalent protactinium in perchlorate solution was studied by different extraction systems. The complexation with acetylacetone, sulfate, ethylenediaminetetraacetic acid, perchlorate and tri-n-octylphosphine oxide suggests that the dominant hydrolyzed protactinium species, in the pH range 0 to 3, is PaO^{3+} (or $Pa(OH)_4^{3+}$). Equilibrium and thermodynamic constants are given for the extraction processes. (auth)

55 EXTRACTION OF ZIRCONIUM BY AMINES FROM SULPHATE MEDIA. Malek, Z.; Schrotterova, D.; Jedinakova, V.; Mrnka, M.; Celeda, J. (Vysoka Skola Chemicko-Technologicka, Prague). pp 477-486 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The mechanism of the extraction of zirconium from aqueous sulphate solutions by tri-n-octylamine (TOA) dissolved in benzene was investigated using chemical and radiometric analysis of the organic phase (with results evaluated by means of the saturation method and logarithmical analysis of the extraction curves). Infrared spectrometry and cryoscopic and viscometric measurements were also employed. Evidence was obtained for zirconium being extracted as a dimeric hydrated sulfato-zirconate of TOA containing 8 R_3NH^+ cations and 8 H_2O molecules per 2 Zr atoms. The ratio of the ligands SO_4^{2-} and OH^- (or O^{2-}) was not determined. (auth)

56 EXTRACTION OF RUTHENIUM AND OSMIUM NITROSOCOMPLEXES. Sinitzin, N. M.; Travkin, V. F.; Plotinskii, G. L.; Svetlov, A. A.; Rovinskii, F. J. (Moscow Inst. of Fine Chemical Tech.). pp 2703-2713 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction of ruthenium and osmium nitrosocomplexes $(M\ NO\ X_5)^{2-}$ has been studied. In these compounds M stands for Os and Ru and X stands for Cl, Br, I, NO_2, OH ligands, aliphatic amine salts, quaternary ammonium and phosphonium compounds, neutral phosphoric reagents (R_3PO) and sulfur-containing compounds (R_2SO). The dependence of osmium and ruthenium extraction on the nature and concentration of acids in aqueous phase and on the nature of internal ligands in osmium and ruthenium nitrosocomplexes as well as on the nature of extractants and diluents in organic phase is shown. Coordinating compounds of nitrosoosmium and ruthenium which are obtained during extraction have been synthesized and studied. The mechanism of extraction of osmium and ruthenium nitrosocomplexes is discussed. (auth)

57 REFLUX AMINE FLOWSHEET FOR PLUTONIUM RECOVERY FROM METALLURGICAL SCRAP. Schulz, W. W.; Bouse, D. G.; Kupfer, M. J. (Atlanta Richfield Hanford Co., Richland WA). pp 2035-2062 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

With the secondary amine, Amberlite LA-2®, as extractant, a new reflux-type solvent extraction process is being developed for possible application in Hanford's Plutonium Reclamation Facility. A conceptual amine process flowsheet, considerably simpler than the presently used tributyl phosphate flowsheet, has been successfully demonstrated in mixer-settler tests. Amberlite LA-2, either in CCl_4 or trichlorobenzene solutions, is satisfactorily resistant to degradation by HNO_3 and/or HNO_2 solutions. Unidentified ligands, which complex Pu(IV) and prevent its stripping with dilute HNO_3, form upon alpha radiolysis of the amine extractant. At expected maximum irradiation doses (20 to 40 watt hr/liter), however, the concentration of these radiolytic products is small and their adverse effect can be largely overcome by periodic washing of the recycled solvent with HNO_3–HF solutions. (auth)

58 DEVELOPMENT AND EXPERIENCE OF INDUSTRIAL OPERATION AND OPTIMISATION OF PULSED MIXER-SETTLER EXTRACTOR. Karpacheva, S. M.; Raginskii, L. S.; Muratov, V. M.; Ivanov, V. D.; Sheloumov, M. V. (State Committee for the Utilization of Atomic Energy, Moscow). pp 231-242 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Operating experiences with mixer-settler extractors are analyzed. It was shown that the dimensions may be substantially reduced by optimization of mixing and settling processes. The optimized "Honeycomb" design was suggested, which was a cocurrent mixing chamber and a settling chamber arranged arbitrarily with respect to the former. The results of hydraulic and engineering tests (using uranyl nitrate solutions) on the bench optimized extractor and the 16-m^3/hr pilot plant model, based on these data, are presented. The extractor has demonstrated high efficiency at the least entrainment. (auth)

59 SIMULATION OF THE STATIC DYNAMIC BEHAVIOUR OF A SOLVENT EXTRACTION PROCESS FOR RARE EARTH SEPARATION. Gaudernack, B.; Muller, T. B.; Nuland, S.; Oerjasaeter, O. (Institutt fuer Atomenergi, Kjeller, Norway). pp 2631-2649 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

In connection with the development of a solvent extraction process for rare earth separation, mathematical models for

static and dynamic simulation of the process as operated in an internally fed, countercurrent multistage cascade were developed. The models are programmed in FORTRAN IV to be used on a CDC CYBER 70 computer. The calculation of solute concentration throughout the cascade is based on some new approaches. These were developed to retain acceptable computing times, when the models are applied for static optimization procedures, evaluation of process control methods or simulation of start-up transients. The equilibrium conditions are described by non-linear relations obtained through the best fit correlations of experimental data. For the static model, good agreement between computed and experimental results has been obtained. The dynamic model, however, gives slightly greater discrepancies due to uncertainties in process input and severe dynamic sensitivities. Revealing these sensitivities has been one of the results most valuable to the understanding of the process performance. (auth)

60 EXTRACTION OF PLATINUM GROUP METALS FROM CYANIDE MELTS WITH LIQUID METALS. Fouche, K. F.; Lessing, J. G. V.; Brink, P. A. (Atomic Energy Board, Pretoria). pp 2685-2701 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Extraction of the platinum group metals, gold, silver, and copper, by liquid bismuth, tin, and zinc, and alloys of these elements from molten (Na, K)CN eutectic, was investigated. A separation scheme for rhodium, iridium, ruthenium, and osmium, based on the selective extraction into liquid metals and alloys, was also developed and it was shown that the method can be integrated with separation methods where rhodium, iridium, and ruthenium are first concentrated in tin or lead buttons. This technique also provides a method for purifying rhodium of iridium impurity with a separation factor of more than 10^3. (auth)

61 SOLVENT EXTRACTION OF ZIRCONIUM AND HAFNIUM WITH SOME TRIFUNCTIONAL PHOSPHATE OXIDES. Bronzan, P.; Meider-Gorican, H. (Institut Rudjer Boskovic, Zagreb). pp 2235-2247 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction of zirconium and hafnium from hydrochloric, perchloric, and sulfuric acid solutions with $[(C_6H_5)_2(O)PCH_2]_2P(O)C_6H_5$ (L_1), $[(C_6H_5)_2(O)PCH_2]_2P(O)OC_2H_5$ (L_2) and $[(C_6H_5)_2(O)PCH_2]_2P(O)OH$ (L_3) has been studied. The properties of the ligands and the formation of the complexes with zirconium and hafnium as well as with perchloric acid were investigated. The influence of the electronegativity of the substituent, bound to the central phosphorus atom, on the extraction of zirconium and hafnium are discussed. From alcoholic solutions of metal tetrachlorides adducts with the phosphine oxides corresponding to the formula $MeCl_4 \cdot L_n$ (Me = Zr or Hf, L_n = ligand) were isolated and characterized. (auth)

62 COMPARATIVE STUDY OF THE RARE EARTH ELEMENTS IN EXTRACTION BY HDEHP/SHELL SOL T FROM NITRIC AND SULFURIC ACID SOLUTION. Alstad, J.; Augustson, J. H.; Danielssen, T.; Farbu, L. (Univ. of Oslo). pp 1083-1102 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Extraction equilibrium data for tracer amounts of all the rare earths (lanthanum series) and yttrium were measured at acidities of HNO_3 and H_2SO_4 up to about 15 N at 25°C. At $a_{H^+} = 1.0$, the extraction constants for the light rare earths were found to be higher with HNO_3 rather than H_2SO_4 in the aqueous phase. The influence of the aqueous rare earth nitrato- and sulfato-complexes on the D-values is discussed. The tetrad effect is found to show up distinctly in the slope analysis, and, with nitric acid in the aqueous phase, anomalies consistent with the presence of the +4 state are found for both Ce and Tb. The rate of extraction, as measured by the AKUFVE technique, is found to be greater with HNO_3 than with H_2SO_4. In the latter case, the time for equilibrium attainment varies with (H_2SO_4), (HDEHP), and Z of the heavier rare earths and of Y. (auth)

63 INVESTIGATION OF RARE-ELEMENTS EXTRACTION WITH DIFFERENT CARBOXYLIC ACIDS. Korpusov, G. V.; Danilov, N. A.; Krylov, Y. S.; Korpusova, R. D.; Drygin, A. I.; Shvartsman, V. Y. (Inst. of Physical Chemistry, Moscow). pp 1109-1128 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

At present carboxylic acids are rather successfully used in rare-earth elements separation. But the data published mainly refer to the technical mixtures of changeable composition. However it is necessary to study the extraction of individual systems to obtain data on process operating parameters. A comparative investigation of extraction systems was carried out based on monocarboxylic acids with different hydrocarbon radicals attached to the carboxylic group. Special attention was paid to α-branched carboxylic acids. Having the branching near the carboxylic group, they may be expected to have a greater selectivity. (auth)

64 EXTRACTION OF AMERICIUM, THORIUM, AND EUROPIUM WITH CAPRYL-HYDROXAMIC ACID (CHA). Pushlenkov, M. F.; Voden, V. G.; Obukhova, M. E. (Radium Inst., Leningrad). pp 1129-1143 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Capryl-hydroxamic acid (CHA) association in octyl alcohol and the rate of its hydrolysis under the influence of nitric acid were investigated. The compositions of precipitates formed by europium and thorium with CHA in aqueous-alcoholic solutions are defined. The influence of CHA concentration, acetate ions and pH value on the behavior of europium and americium with CHA solution in octyl alcohol were studied. Americium and europium extraction mechanisms with CHA are proposed; the argument for such mechanisms is based on the compositions of the mixed salts being formed and the distribution data. (auth)

65 EXTRACTION OF THE RARE EARTH ELEMENTS WITH PHOSPHINE-, AMINE-, AND SULPHOXIDES. Mikhailichenko, A. I.; Kotliarov, R. V.; Sokolova, N. P.; Abramov, L. A. (Gosudarstvennyi Inst. Redkikh Metallov, Moscow). pp 1059-1072 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction of rare earth nitrates by neutral oxygen-containing extractants increases along the series TBP < DOSO < HTSO < DAMP < NPO < TOAO < TAPO at pH 5.5, and at pH 1.0 along the series TOAO < TBP < DOSO < HTSO < NPO < DAMP < TAPO. The difference in the sequence of the extractants is due to changes in the amount of nitric acid extracted. The data obtained on metal – and water – distribution and IR spectra showed that rare earths are extracted by phosphine-, amine- and sulfoxides (expecting TOAO) as anhydrous trisolvates $Ln(NO_3)_3 \cdot 3S$. When rare earths are extracted by neutral oxygen-containing extractants of the same class the extractant strength and selectivity change in parallel. Generally when extractants of different classes (e.g., sulfoxides and amine-oxides) are compared, there is no correlation between extractant strength and selectivity. The features in the shape of the plots of distribution coefficient vs. rare earth element atomic number (tetrad effect) for five extraction systems are discussed. Conclusions concerning the influence of the tetrad effect on the separation factors for adjacent rare earth elements in systems of different type are formulated. (auth)

66 ALKALI METALS EXTRACTION BY THE CYCLIC POLYETHER DIBENZO-18-CROWN-6. Danesi, P. R.; Meider-Gorican, H.; Chiarizia, R.; Capuano, V.; Scibona, G. (CNEN, Casaccia, Italy). pp 1761-1774 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction of the alkali cations (Li^+, Na^+, K^+, Rb^+, Cs^+) by the neutral cyclic polyether dibenzo-18-crown-6 dissolved in various nitrobenzene–toluene mixtures was studied. Thermodynamic data were so obtained regarding both the alkali cation-cyclic polyether reaction as well as the ion pair formation in the organic phase. The affinity of the cyclic polyether for the alkali cations was found to vary in the order K^+, Rb^+, Cs^+, Na^+, Li^+ for all the diluent compositions. Moreover the independence of the selectivity constant, defined as the equilibrium constant of the reaction: $Cs^+ + \overline{MSX} \rightleftharpoons \overline{CsSX} + M^+$ (where M is the alkali cation, S the cyclic polyether, X the picrate ion and the bar indicates organic species) on the diluent composition, as well as the independence of the ion pair formation constant from the type of alkali cation, seem to indicate that the complexes formed with the cyclic polyether are isosteric (i.e., with size, shape and external electronic distribution independent of the chemical nature of the cation). (auth)

67 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. XXI. Kinetics and Equilibria of Extraction of Eu(III) by Di(2-Ethylhexyl) Phosphoric Acid from Complexing Media. Kolarik, Z.; Kuhn, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 2593-2606 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The rate and equilibria of Eu(III) extraction by di(2-ethylhexyl) phosphoric acid (HDEHP), in some cases in the presence of other organophosphates, from aqueous solutions of diethylenetriaminepentaacetic acid (DTPA) and an additional carboxylic acid complexant were studied. Under conditions of dispersion mixing the first-order rate constant of the extraction reaction was found to depend on the stirring velocity as well as the nature of the diluent and the additional complexant. With n-dodecane as the former and lactic acid as the latter the rate constant and equilibrium distribution coefficient were measured as functions of the concentrations of DTPA, lactic acid and hydrogen ions in the aqueous phase and of HDEHP, tri-n-butyl phosphate and mono-2-ethylhexyl phosphoric acid in the organic phase. The extraction mechanism is discussed. (auth)

68 CHEMICAL SEPARATIONS FOR SUPER-HEAVY ELEMENT SEARCHES IN IRRADIATED URANIUM TARGETS. Horwitz, E. P.; Bloomquist, C. A. A. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 37: No. 2, 425-434(Feb 1975).

A chemical procedure is outlined for super-heavy element searches in irradiated uranium targets. The separation scheme is based on the wide range in stability and extractability of chlorometallic complexes by alkyl tertiary and quaternary ammonium chlorides and the wide range of extractability of metal ions by di-2-ethylhexylorthophosphoric acid. These two properties are utilized in various extraction chromatographic systems. The procedure was developed using elements in the sixth period as chemical homologues of super-heavy elements and tested on 100- to 200-mg irradiated uranium targets. The separation schemes are also applicable to other irradiated targets. (auth)

69 SOLVENT EXTRACTION IN INORGANIC ANALYTICAL CHEMISTRY. Lyle, S. J. (Surrey Univ., Guildford, Eng.). Selec. Annu. Rev. Anal. Sci.; 3: 1-57(1973).

The subject is reviewed under the following headings: general reviews and monographs; laboratory apparatus and technique; kinetic aspects of extraction; some thermodynamic properties, solubility and salt effects; equilibrium and mechanistic aspects of extraction; applications (separation and concentration; determination of the metal in the non-aqueous phase). The elements covered include the following: Be, B, Cd, Cs, Ce, Eu, Hf, In, I, La, Lu, Mo Nb, Re, Ru, Sc, Sr, Ta, Te, Tm, V, W, Y, Zr, Am, Ac, Cf, Cm, Np, Pa, Po, Pu, Th, and U. (UK)

70 INVESTIGATION OF EXTRACTION AND SOME PROCESSES OF SEPARATION OF ALKALI-EARTH ELEMENTS. Brezhneva, N. E.; Korpusov, G. V.; Prokhorova, N. P.; Prokopchuk, Y. Z.; Svetlakov, V. I.; Trukhanov, S. Y. (Inst. of Physical Chemistry, Moscow). pp 1737-1760 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Previous publications (Prokopchuk et al., Radiokhimiya; 13:2:245 (1971); 15:1:35 (1973); and 15:N1:42 (1973)) reported on alkaline earth element extraction with oxine, its haloid derivatives, and salicyl aldoxime. The latter, having good capacity, gives higher values of separation coefficients of calcium-strontium, and strontium-barium as compared with D2EHPA. But this reagent is not produced on a large scale. The present paper deals with possibilities of other extractants in common use, such as TBP, D2EHPA, and some others, mainly different carboxylic acids, which have the advantage of being inexpensive and available in unlimited quantities. (auth)

71 PENTAVALENT NEPTUNIUM EXTRACTION BY CHELATE FORMATION FROM BASIC MEDIA. Guillaumont, R.; Genet, M.; Galin, M. (Paris Univ., Orsay, France). pp 443-449 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The solvent extraction of Np(V) from NaOH solutions into tert-butyl acetate-tert-butyl alcohol (S) organic phases by chelate formation with dibenzoylmethane (HA) was investigated. Variation of D_{Np} with pH and with the chelating reagent or alcohol concentration indicates that the species extracted are $NpO_2A \cdot 3HA$ and $NpO_2A \cdot 2HA \cdot S$ near pH 14, and $NpO_2A \cdot nS$ (n = 0,1,2 and 3) between pH 12 and 13. (auth)

72 THERMODYNAMIC ACTIVITY MODEL FOR A SINGLE LANTHANIDE NITRATE LIQUID-LIQUID EXTRACTION SYSTEM. O'Brien, W. G.; Bautista, R. G. (Ames Lab., Iowa). pp 1399-1408 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A thermodynamic model for a single component extraction system has been developed by making use of the thermodynamic activity of the various species, the stability constants of the inorganic complexes formed and by defining the solvent extraction equilibrium constants. An equation is presented for the liquid-liquid extraction of a lanthanide from an acidic lanthanide nitrate solution by di(2-ethylhexyl)phosphoric acid. (auth)

73 SEPARATION OF MOLYBDENUM AND TUNGSTEN BY A LIQUID-LIQUID ION-EXCHANGE METHOD. Esnault, F.; Robaglia, M.; Latard, J. M.; Demarthe, J. M. (CEN, Fontenay-aux-Roses, France). pp 2765-2785 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A process for the recovery of molybdenum values and tungsten values from a molybdenum contaminated alkaline solution of tungsten values, was carried out on a laboratory scale. This process included acidifying the solution to a pH of 3 to 3.5 contacting the solution with an organic extractant di(2-ethylhexyl)phosphoric acid, diluted in an inert hydrocarbon in the presence of ethyl-2-hexanol-1. Thus molybdenum is selectively extracted, more readily when the tungsten concentration is low. Then molybdenum is stripped by an aqueous ammonia solution. The mother liquor, now molybdenum free, is contacted with an amine dissolved in an organic diluent capable of forming a tungstate amine complex. Then tungsten is stripped by an aqueous ammonia solution. (auth)

74 EXTRACTION OF SOME UNIVALENT AND BIVALENT METALS IN THE PRESENCE OF MACROCYCLIC POLYETHER. Rais, J.; Kyrs, M.; Kadlecova, L. (Ustav Jaderneho Vyzkumu, Rez, Czech.). pp 1705-1715 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The selectivity of extraction of microamounts of Na^+ and Ca^+ ions in the presence of Li^+DPA^- (DPA^- = dipicrylaminate) and into six organic solvents was studied. In other experiments the extraction of Ca^{2+}, Sr^{2+}, and Ba^{2+} in the presence of polyhedral borate sandwich anion $(B_9C_2H_{11})_2Co^-$ was investigated. In all experiments the macrocyclic polyether was dibenzo-18-crown-6. (auth)

75 METAL EXTRACTION BY DI-N-HEPTYLSULPHOXIDE (DHpSO); APPLICATION IN A PULSED COLUMN. Laurence, G. (Ecole Nationale Superieure de Chimie, Paris); Habsieger, D.; Talbot, J.; Chaieb, M. T.; Michel, P. pp 2271-2288 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Characteristics of molar solutions of di-n-heptylsulfoxide (DHpSO) in 1,1,2-tri-chloroethane (TCE) are recalled and the properties of this solvent are recapitulated for metals extraction (U, Th, Mo, Ce, Zr, Hf, Fe, Co, Ni, Mn, Cu, Al, ...). Two examples of application in a pulsed column are given. They deal with zirconium-hafnium separation in nitric acid medium, and iron purification in hydrochloric acid medium. The main characteristics of the column are: height 4 m, diameter 4 cm, perforated plates made of "teflon." The results show perfect behavior of the solvent in the pulsed column. (auth)

76 SYNERGIC EXTRACTION OF METALS BY THE MIXTURES OF TRI-N-OCTYLAMINE WITH A NEUTRAL EXTRACTANT FROM NITRATE AND CHLORIDE SOLUTIONS. Spivakov, B. Y.; Myasoedov, B. F.; Shkinev, B. M.; Kochetkova, N. E.; Chmutova, M. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). pp 2577-2583 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The solvent extraction of the trivalent transplutonium elements (TPE), Eu, Th, Zr from nitrate solutions and Am and Eu from chloride solutions by the mixtures of tri-n-octylamine (TOA) with tributyl phosphate (TBP) and trioctylphosphine oxide (TOPO) in different diluents was studied. A considerable synergic effect was observed in the extraction of TPE and Eu by the mixtures of TOA and TBP. The effect increases with increasing salting-out agent concentration giving extraction of TPE from nitrate and chloride solutions with high distribution coefficients. A mixture of TOA and TBP can be successfully used for the extraction of TPE from acidic nitrate solutions. A synergic effect was also found for Th. The methods of IR spectroscopy and electrophoresis have been used to confirm a suggestion of the authors that the synergic effect is due to the formation of mixed anionic complexes of the metals containing inorganic ligands and co-ordinated molecules of the neutral extractant. (auth)

77 ^1H- AND ^{31}P-NMR STUDY OF LIGAND EXCHANGE KINETICS IN THE SYSTEMS $UO_2(NO_3)_2$-TBP AND $Pu(NO_3)_4$-TBP.

von Ammon, R. (Kernforschungszentrum, Karlsruhe, Ger.). pp 2512-2526 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The kinetics of the ligand exchange reaction M.2TBP + $TBP^x \rightleftharpoons$ M.TBP.TBP^x = TBP were studied by ^1H- and ^{31}P-NMR line shape analysis. The free energy of activation ($\Delta G^{\ddagger}$) of this first order reaction depends strongly on (i) the metal ion (UO_2^{+2} and Pu^{+4}, resp.), (ii) the presence of HNO_3, and (iii) the solvent. TBP exchanges much faster with the plutonium than with the uranium complex; the exchange is slowed down by the presence of hydrogen-bonded HNO_3 and by polar solvents. The results indicate that the metal-TBP complexes interact with TBP by dipolar forces. The activated state presumably is an associate of the type M.3TBP. Evidence for this and against a dissociative mechanism is provided by rather high, negative values of the free entropy of activation ($\Delta S^{\ddagger}$) suggesting a highly ordered activated state. (auth)

78 USE OF FORMIC ACID FOR THE STRIPPING OF PLUTONIUM. Germain, M. (CEN de Fontenay-aux-Roses, France); Bathellier, A.; Berard, P. pp 2075-2092 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A new extraction process is proposed in which the stripping of plutonium is effected by a mixture of formic acid and nitric acid. When high concentrations of plutonium and/or high concentration factors are required, an alternative process which combines the complexing action of formic acid and the reducing properties of hydroxylamine is used. The processes were tested successfully on the laboratory scale in the conditions of the final purification of plutonium as well as those of the separation of uranium from plutonium. The formic solutions of plutonium can then be boiled to destroy formic acid and increase plutonium concentration, or the plutonium may be precipitated as a solid compound. (auth)

79 SYNERGIC EFFECTS IN LIQUID–LIQUID EXTRACTION OF SOME HEAVY METALS BY 1-PHENYL-3-METHYL-4-BENZOYL-PYRAZOL-5-ONE. Navratil, O. (Purkyne Univ., Brno). pp 2585-2592 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The solvent extraction of zinc (II), cobalt (II), cerium (III) and europium (III) from an aqueous perchlorate and nitrate solution into benzene or toluene by mixtures of 1-phenyl-3-methyl-4-benzoyl-pyrazol-5-one (HA) and electroneutral organic bases, S, (where S = TBP, TEHP, TBPO, TOPO, quinoline or isoamyl alcohol) shows a synergic effect due to the extraction of a mixed species MA_2S_n (M = Co, Sn) and MA_3S_n (M = Ce, Eu), n = 1 and/or 2. The stability of the complexes $MA_N(HA)_r$, r = 0 or 1, and of the adducts was calculated from the extraction curves. (auth)

80 BEHAVIOR OF ION EXCHANGE RESINS TOWARD CHLORIDES. Rozenberg, J.; Dolle, L.; Darras, R. Trans. Amer. Nucl. Soc.; 20: 187-189(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

81 SELECTIVE SEPARATIONS OF IODINE, TECHNETIUM, CAESIUM, AND ALKALI IONS. Lieser, K. H. (Technische Univ. Darmstadt (F. R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Z. Anal. Chem.; 273: No. 3, 189-192(1975).

From international IUPAC congress on analytical chemistry; Kyoto, Japan (3 Apr 1972).

Selectivity is defined between the logarithms of distribution coefficients. The following examples of selective separations are presented: Compounds of silver for separation of iodine, cadmium sulfide for separation of technetium, titanium hexacyanoferrate for separation of cesium, and polystyrene containing tetraphenylborate as functional group for separation of alkali ions. (auth)

82 KINETICS OF URANIUM, PLUTONIUM, RUTHENIUM, AND ZIRCONIUM EXTRACTIONS WITH TRIBUTYL PHOSPHATE. Pushlenko, M. F.; Shchepetilnikov, N. N.; Kuznetsov, G. I.; Kasimov, F. D.; Yasnovitskaya, A. L.; Yakovlev, G. N. (Radium Inst., Leningrad). pp 493-513 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The kinetics of centrifugal extraction of uranium, plutonium, ruthenium, zirconium and nitric acid with tributyl phosphate were investigated. An experimental technique was developed for making these measurements. The rate of uranium plutonium and nitric acid extraction is diffusion controlled. The period of mass transfer (98 to 99% of the equilibrium state) varies from 0.6 to 6 sec. The rate of ruthenium extraction is limited by slow chemical reactions in the aqueous phase. It is shown that the centrifugal extractor can be effectively used for uranium and plutonium extraction. In some cases the distribution ratios of the elements can be changed by taking into account the differences in the rate of their extraction. (auth)

83 USE OF 5-(4-PYRIDYL)NONANE FOR THE SEPARATION OF CHROMIUM(IV) FROM FISSION PRODUCTS IN HYDROCHLORIC ACID MEDIA. Igbal, M.; Ejaz, M. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). Talanta; 22: No. 2, 143-149(Feb 1975).

The distribution of chromium(VI) between 5-(4-pyridyl)nonane in benzene and hydrochloric acid media has been studied as a function of the concentration of the acid, extractant, chromium(VI), chloride and a few other ions. The extraction mechanism and the composition of the extracted complexes of Cr(VI) have been proposed. The separation of Cr(VI) from uranium, thorium, and fission products in 3M hydrochloric acid has been achieved. (auth)

84 CHROMATOGRAPHIC BEHAVIOUR OF 48 CATIONS ON STANNIC AND TITANIUM ARSENATE PAPERS IN AQUEOUS NITRIC ACID SYSTEMS. Qureshi, M.; Sharma, S. D. (Aligarh Muslim Univ., India). Talanta; 22: No. 2, 129-133(Feb 1975).

The chromatographic behavior of 48 metal ions on titanium arsenate, stannic arsenate and Whatman No. 1 papers in 10^{-5}–3M nitric acid has been studied along with the effect of pH on R_M. The metals studied included: Be, Cs, Cd, Ce, Hf, In, La, Mo, Nd, Nb, Pr, Ru, Sr, Sm, Th, U, V, W, Y, Zr. (auth)

85 EXTRACTION OF TRIVALENT TRANSPLUTONIUM ELEMENTS AND EUROPIUM BY A MIXTURE OF DI-2-ETHYLHEXYLORTHOPHOSPHORIC ACID AND PHOSPHORUS PENTOXIDE FROM STRONGLY ACID MEDIA. Myasoedov, B. F.; Chmutova, M. K.; Kochetkova, H. E.; Pribylova, G. A.; Vernadskii, V. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). pp 1103-1108 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction of trivalent transplutonium elements (Am, Cm, Bk, Cf) and europium from solutions of inorganic acids by a mixture of di-2-ethylhexylorthophosphoric acid (HDEHP) and P_2O_5 in cyclohexane has been investigated. It is shown that the proposed mixture of reagents quantitatively extracts Am and Eu from solutions of acids of sufficiently high concentration. Large amounts of aluminum and ammonium nitrates, at HDEHP and P_2O_5 concentrations equal to 0.3M and 0.1M respectively, do not interfere with extraction. The extractant exhibits low-selectivity with respect to trivalent transplutonium elements (TPE). (auth)

86 STUDY OF THE Zr(IV) AND Hf(IV) MONOMER IONS IN ACID AQUEOUS SOLUTIONS BY LIQUID–LIQUID EXTRACTION. Tribalat, S.; Schriver, L. (Paris-6 Univ., 75 (France)). Compt. Rend., Ser. C; 279: No. 11, 443-446(9 Nov 1974). (In French).

A quantitative study of the extraction equilibrium of Zr(IV) and Hf(IV) perchlorates and thiocyanates by methyl isobutyl ketone and isopropyl tropolonates by chloroform (using ^{95}Zr and ^{181}Hf isotopes) shows that the Zr and Hf monomer ions in perchloric acid solutions 0,5 to 4M are mainly $Zr(OH)^{3+}$ and $Hf(OH)^{3+}$. The respective equilibrium constants were determined. (FR)

87 SEPARATION OF SILVER FROM ACCOMPANYING METALS BY SOLVENT EXTRACTION WITH BISMUTH DI-2-ETHYLHEXYLDITHIOPHOSPHATE. Yukhin, Yu. M.; Levin, I. S.; Meshkova, N. M. (Inst. of Physicochemical Principles of Processing Mineral Raw Materials, Novosibirsk, USSR). Zh. Anal. Khim.; 30: No. 2, 261-264(Feb 1975). (In Russian).

Silver can be separated from large amounts of alkali, alkaline earth, rare earth metals, Al, Ga, Ti(IV), Cr(III), Mn(II), Zr, Zn, Cd, In, Tl(I), Sn(II), Pb, As(III), Sb(III), Bi, Co, Ni, Au(III), Hg(II), Pd, and other elements by extraction with bismuth di-2-ethylhexyldithiophosphate from mineral acid solutions. A procedure was developed of determining silver microamounts in various materials. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 1539.

88 (RD/B/N-2350) ELECTROCHEMICAL MEASUREMENT OF CARBON POTENTIAL. Part III. Preliminary Gas Phase Studies Involving Carbon Monoxide. Gwyther, J. R.;

Hobdell, M. R.; Tyfield, S. P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The occurrence and extent of metal (de)-carburisation and carbon deposition in metal–gas systems depend on the carbon activity of the gas phase. An electrochemical technique for the direct measurement of carbon activity has been tested for use in gaseous environments. Initial studies were conducted with carbon monoxide. The technique was found suitable for use in the temperature range 824 to 950°K, providing that the gas phase was compatible with a carbon permeable α-iron membrane electrode. Carbon diffusivity values in α-iron were obtained from analysis of emf-time profiles. The technique provides a convenient method of studying carbon diffusion and deposition processes, and could prove of value in monitoring loop and reactor gas-phase carbon activities. (auth)

Chemical and Physicochemical Properties

Refer also to abstracts 168, 1303, and 1341.

89 (COO-3273-1) USE OF TRACERS IN STUDYING THE MECHANISM OF CATALYTIC REACTIONS. Final Report, July 1957–July 1971. Emmett, P. H. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1971. Contract AT(11-1)-3273. 41p. Dep. NTIS $5.25.

Research results obtained during the period July 1957 to July 1971 are briefly summarized. The work and accomplishments are grouped into four categories: catalytic cracking and cracking catalysts; iron catalysts for ammonia synthesis; equation of state work; and miscellaneous. (LK)

90 (MLM-2221) STABLE ISOTOPES OF XENON: A BIBLIOGRAPHY. Stringham, W. S. (comp.). (Mound Lab., Miamisburg, Ohio (USA)). 1 May 1975. Contract AT-33-1-GEN-53. 141p. Dep. NTIS $5.45.

A listing of selected references and abstracts is presented of chemical, nuclear, and physical properties, analytical and production methods, and uses of the xenon stable isotopes. (auth)

91 TRANSPORT OF MATTER IN SOLIDS. Frischat, G. H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (F. R. Germany). Lehrstuhl fuer Glas und Keramik). Angew. Chem.; 86: No. 12, 428-442(Jun 1974). (In German).

Two aspects are of particular importance in the transport of matter in solids: the phenomenological description of the diffusion process and discussion of the transport mechanism. Besides the self-diffusion of the ion or atom making up a solid, which can only be traced with radioactive or stable isotopes, there is the diffusion of trace elements, which can in principle be treated like self-diffusion, and the chemical diffusion in which the chemical composition of the diffusion partner differs. These kind of processes are increasingly being detected by the electron beam microprobe. Diffusion problems on solids can be discussed according to gradual adaptation to the special structural conditions under common aspects independently of the crystallinity and the kind of bonding. (GE)

92 THE PECULIARITIES OF THE REACTION OF SODIUM AND WATER IN VESSELS. Schnitker, W. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Atomkernenergie; 24: No. 4, 233-242(1974).

The reaction of sodium and water in vessels was studied experimentally. The results were evaluated by means of a computer program assuming the previous model concept of this reaction. Parameters were varied in the calculation to clarify discrepancies between calculation and measurement. This was carried out by a special superimposed program. The hydrogen following the sodium is still mixed with very small sodium droplets. This causes extremely high pressure losses during accelerations. The hydrogen is rapidly cooled by the large sodium surface of the droplets. In addition, the hydrogen loses mass by diffusion of hydrogen into the sodium. When saturation has been reached sodium hydride formation takes place. (auth)

Isotope Effects

Refer also to abstracts 141, 1544, and 1916.

93 (AD-787668) SIMULTANEOUS DIFFUSION OF TWO OR MORE IONS IN THE PRESENCE OF INTERNAL ELECTRIC FIELDS. Deford, J. W.; Johnson, O. W. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 1974. 15p. NTIS $3.25.

The theory of diffusion in the presence of internal electric fields developed in the preceding paper is generalized to the case of simultaneous diffusion of more than one species. It is shown that for the case of two chemically similar impurities, an experiment can be devised which virtually eliminates the effects of these internal fields, making possible accurate measurement of diffusion parameters. The theory is applied to H-D diffusion in rutile and it is shown that the main effect of the internal fields is to reduce the difference between the two diffusion coefficients while keeping the average nearly constant. Detailed calculations for the system are presented. (auth)

94 (UCI-34P-188X4) THEORETICAL STUDIES ON ISOTOPIC MASS EFFECTS IN CHEMISTRY. Progress Report. (California Univ., Irvine (USA)). 1974. Contract AT(04-3)-34. 10p. Dep. NTIS $4.00.

Progress in the following studies is reported: refinements in the theory of isotope effects on equilibrium constants; studies of isotope effects on a variety of properties; and energy transfer. (LK)

95 KINETIC ADSORPTION ISOTOPE EFFECT OF CH_4 AND CD_4 IN MOLECULAR FLOW EXPERIMENTS. Roth, W.; Gottwald, B. A.; Haul, R. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Physikalische Chemie und Elektrochemie). Z. Naturforsch., a; 29: No. 11, 1614-1621(Nov 1974). (In German).

Transient molecular flow studies of CH_4, CD_4 and mixtures using a Pyrex glass capillary were carried out under uhv conditions at temperatures between 77.4 and 115°K and pressures between 10^{-5} and 10^{-3} Torr ($10^{-3} < \text{theta} < 10^{-1}$). The simultaneous recording of different components of the gas mixtures is achieved by means of a quadrupole mass spectrometer. The temperature dependence of the observed adsorption isotope effects is discussed in terms of the changes of the internal and external vibrations of the molecules caused by adsorption. The behavior of gas mixtures was simulated by a numerical calculation. (auth)

96 CHEMICAL REACTION KINEMATICS. P. 18. Reactions of NH_3^+ and NH_3^+ with Hydrogen and of N^+ with HD. Elsele, G.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie); Botschwina, P.; Meyer, W. (Mainz Univ. (F. R. Germany). Inst. fuer Physikalische Chemie). Ber. Bunsenges. Phys. Chem.; 78: No. 10, 1090-1097(Oct 1974).

The angular energy distributions of the productions of various reactions $NH_n^+ + H_2 \rightarrow NH_{n+1}^+ + H$ were measured at collision energies from 0.4 to 10 eV (c.m. system). The relative intensities and energy distributions of the ions produced in the reactions with D_2 were also investigated. The essential features of the reaction potential surface of $NH_3^+ + H_2$ were calculated by the unrestricted Hartree–Fock method. NH_3^+ reacts with D_2 in an impulsive manner at all collision energies used, picking up a D atom. Simultaneously, the NH_3D^+ ion formed is unreactively or reactively scattered on the remaining D atom and NH_3D^+ or NH_2D^+, respectively, is the production observed. At the lowest collision energy used, NH_2D^+ is even more abundant than NH_3D^+. The cross-section has a maximum at about 2 eV (c.m. system). Although a deep potential well of more than 5 eV exists in the potential hypersurface of the reactions of NH_2^+ and of NH^+ with H_2, they become noticeably impulsive at a c.m. collision energy of 1 eV. The symmetric intensity distribution around the c.m. point observed at smaller energies indicates a strong interaction of the freed hydrogen atom with incident ions. Complex formation in the reaction of NH_2^+, which has a small cross section, may contribute at low energies. Complexes are less important in the reaction of NH^+ which has a large cross section because of a high rotational energy barrier. The reaction of N^+ with HD was found to occur in an impulsive manner. At low energies, the velocity distribution indicates a strong interaction between the freed hydrogen atom and the incident ion. The intensity ratio NH^+/ND^+ of the two products of the reaction with HD is smaller than unity below 4 eV and increases at higher energies. (auth)

97 KINETIC ISOTOPE EFFECT IN REACTIONS INVOLVING THE PROTOPHILIC ISOTOPE EXCHANGE OF HYDROGEN IN CH-ACIDS WITH DIMETHYLSULFOXIDE. II. Reactions Catalyzed By $CH_3S(O)CH_2K$. Romanskii, I. A.; Shapiro, I. O.; Shatenshtein, A. I. (Physical-Chemical Inst., Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 15: No. 4, 786-789(1974).

Translated from Kinet. Katal.; 15: No. 4, 879-882(1974).

The k_D/k_T ratios which equalled 2.8-3.1 were obtained for reactions involving the isotope exchange of the hydrogen in toluene and 1,3,5-trimethoxybenzene with dimethylsulfoxide, which were catalyzed by potassium dimsyl ($CH_3S(O)CH_2K$, PD). These results show that the step in which the proton is detached from the CH-acid molecule is the rate determining one within the framework of the mechanism of the reactions involving the protophilic isotope exchange of hydrogen which was taken from the literature. The mechanisms of the isotope exchange reactions of the hydrogen in CH-acids with DMSO catalyzed by potassium tert-butylate and PD are compared. (auth)

98 INTERNAL HEAVY–ATOM EFFECT IN PORPHYRIN MOLECULES. 2: HALOGEN DERIVATIVES OF

DEUTEROPORPHYRIN IX. Gradyushko, A. T.; Kozhich, D. T.; Sokolev, K.N.; Tsvirko, M.P. Opt. Spectrosc. (USSR) 37: No. 5, 510-512 (Nov 1974).

The spectral luminescence properties of halogen derivatives of deuteroporphyrin IX (containing halogen atoms at the 2,4 positions of the pyrrole rings) and their complexes with zinc have been investigated. As the atomic number of the halogen increases, the phosphorescence spectra of the zinc complexes are substantially altered. A considerable intensification of the vibronic bands with frequencies of ~ 150 cm^{-1} and ~ 700 cm^{-1} is observed. Within a three-level diagram, all the probabilities of radiative and radiationless transitions have been determined. Possible mechanisms of spin-orbit perturbation are discussed. The substantial role of electronic-vibrational interactions in the photophysics of the halogen derivatives of deuteroporphyrin is shown. (auth)

99 KINETIC ISOTOPE EFFECT IN Tl(III) OXIDATION OF ALCOHOLS. Srinivasan, V. S.; Venkatasubramanian, N. (Vivekananda Coll., Madras). Indian J. Chem.; 12: No. 9, 990-991 (Sep 1974).

Thallium(III) oxidation of benzhydrol has a kinetic isotope effect $k_H/k_D = 6.4$. p-Chlorobenzhydrol is oxidized slower and the Hammett ρ is found to be -2.53. These results confirm that the Tl(III) oxidation of secondary alcohols involves a $-C-H$ cleavage with the hydrogen being lost as a hydride anion. (auth)

100 ISOTOPE EFFECT IN THE RADICAL PHENYLATION OF 3-DEUTERIO-4-METHYL PYRIDINE. Vidal, S.; Court, J.; Bonnier, J. M. (Grenoble-1 Univ., 38 (France)). Compt. Rend., Ser. C; 279: No. 18, 797-800(28 Nov 1974). (In French).

The radical phenylation of 3-deuterio-4-methyl pyridine by benzol peroxide leads to an isotope effect of 3.7; this effect disappears in the presence of oxidizing agents. The isotope composition of the substrate, before and after the phenylation reaction, shows that the observed isotope effect is not due to the reversible addition of the phenyl radical to the substrate. (FR)

Isotope Exchange and Isotope Separation

101 ISOTOPE EXCHANGE IN OXYGEN AND HYDROGEN DURING REACTION ON PLATINUM. Kuchaev, V. L.; Nikitushina, L. M.; Temkin, M. I. (Inst. of Physical Chemistry Scientific-Research, Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 15: No. 4, 859-863(1974).

Translated from Kinet. Katal.; 15: No. 4, 963-968(1974).

A study was performed at pressures of the order of 10^{-5} torr and temperatures of 300 to 560°C. As the rate of the reaction of hydrogen with oxygen on platinum increases, due to an increase in hydrogen partial pressure, the rate of homomolecular isotope exchange in oxygen decreases. Exchange completely stops when the rate of reaction ceases to grow with increase in hydrogen pressure. Homomolecular isotope exchange in hydrogen, on the contrary, takes place at an appreciable rate only in the region where the reaction rate is independent of hydrogen pressure. The data obtained support the mechanism proposed to explain the kinetics of the reaction of hydrogen with oxygen. (auth)

102 SOLID STATE ISOTOPIC EXCHANGE REACTION BETWEEN CATIONIC AND ANIONIC Co ATOMS IN $[Co(H_2O)_6][Co\ EDTA]_2 \cdot 4H_2O$. Lazzarini, E.; Fantola Lazzarini, A. L. (Politecnico di Milan). J. Inorg. Nucl. Chem.; 37: No. 2, 407-411(Feb 1975).

The solid state isotopic exchange reaction between cobalt atoms in cationic and anionic sites in the double complex $[^{60}Co(H_2O)_6][Co\ EDTA]_2 \cdot 4H_2O$ was investigated in order to observe: (1) whether isotopic exchange reactions between atoms at the normal lattice sites of the double complex can occur as they do between dopant ions and atoms of the host matrices; (2) whether the thermodynamic equilibrium value of the fraction of activity exchanged is attained in this class of compounds, since attainment of the thermodynamic equilibrium conditions is rarely observed in doped crystals. It was found that in the above double complex the exchange between cobalt atoms in cationic and anionic sites has a negligible probability of taking place by cooperative motion in the ring of two cobalt atoms, one at a cationic site and the other in a neighboring anionic site. The presence in the solid of vacant cobalt sites in anionic positions seems essential to the isotopic exchange. This conclusion was reached by comparing the isotopic exchange reaction in irradiated (100 Mrad) and unirradiated crystals. In neither case was the thermodynamic equilibrium value of the exchanged activity fraction attained, but the final fraction is higher by a factor 5.5 in irradiated than in unirradiated crystals. The isotopic exchange in unirradiated crystals occurs simultaneously with the dehydration of the compound which probably induces in the solid a defect concentration higher than that corresponding to the equilibrium value. (auth)

103 DIFFERENCES BETWEEN HOMOGENEOUS AND HETEROGENEOUS METAL CATALYSIS. Isotope Orientation in the Platinum-Catalysed Exchange of the Polyphenyls, Particularly O-Terphenyl. Davis, K. P.; Garnett, J. L. (New South Wales Univ., Kensington, Australia). J. Chem. Soc., Chem. Commun.; No. 3, 79-80(5 Feb 1975).

O-Terphenyl is a good marker compound for distinguishing between homogeneous and heterogeneous metal-catalyzed reactions, particularly isotope exchange; differences in deuterium orientation are observed during initial rates of exchange in o-terphenyl with each catalytic system, these differences being attributed to a particular conformation of o-terphenyl in the adsorbed state. (auth)

104 CALCULATIONS OF THE OXYGEN ISOTOPE FRACTIONATION BETWEEN HYDRATION WATER OF CATIONS AND FREE WATER. Bopp, P.; Heinzinger, K.; Vogel, P. C. (Max-Planck-Institut fuer Chemie (Otto-Hahn-Institut), Mainz (F. R. Germany)). Z. Naturforsch., A; 29: No. 11, 1608-1613(Nov 1974).

The oxygen isotope fractionation factors between the hydration complex of the alkali ions in the gas phase and a free water molecule were computed on the basis of the energy surfaces calculated by Kistenmacher, Popkie and Clementi for a water molecule in the field of an alkali ion. For comparison with recently measured oxygen isotope fractionation factors in aqueous alkali halide solutions, the gas phase values were multiplied with the corresponding separation factors between water vapor and liquid water, thus relating the hydration complex in the gas phase with pure water. Qualitative agreement between computed and observed fractionation factors was found for H_2O and D_2O. (auth)

105 EXCHANGE REACTIONS OF HD, D_2, AND $H_2 + D_2$ MIXTURES, AND THE DECOMPOSITION OF FORMIC ACID MOLECULES HCOOH, DCOOH, AND HCOOD ON BORON PHOSPHATE. Scott, L. G. Waterloo, Ont.; Univ. of Waterloo (1974). vp.

Thesis (Ph. D.).

The exchange of D_2, HD and $H_2 + D_2$ mixtures, and the decomposition of formic acid and deutero-formic acids were employed in the study of the surface and catalytic properties of boron phosphate. The reactions were carried out in a static system of constant volume. Analysis of the products was accomplished by the use of mass spectrometry. Kinetic data for the hydrogen exchange reactions fitted standard first order equations. Absolute rate constants varying from $0.984-6.397 \times 10^{15}$ molecules m^{-2} sec^{-1} and activation energies in the range of 7.0-15.2 Kcal/mole were measured, with these values dependent upon reaction temperature, catalyst composition and pretreatment. The gain of D-atoms by the surface was found to fit the Elovich equation. Two catalysts were prepared for this work by mixing boric and orthophosphoric acids in ratios of 1 : 1.12 and 1 : 1.17. Surface areas were determined before and after each reaction. The kinetic study of the decomposition of formic acid was qualitative. A mechanism involving surface hydrogen was proposed for this reaction. (Diss. Abstr. Int., B)

106 MOLECULAR BEAM STUDY OF THE MECHANISM OF CATALYZED HYDROGEN-DEUTERIUM EXCHANGE ON PLATINUM SINGLE CRYSTAL SURFACES. Bernasek, S.L.; Somorjai, G.A. (Inorganic Materials Research Division. Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 62: No. 8, 3149-3161 (15 Apr 1975).

The hydrogen–deuterium exchange reaction was studied by molecular beam scattering on low and high Miller index crystal faces of platinum in the surface temperature range of 300–1300°K. Under the condition of the experiments which put strict limitation on the residence time of the detected molecules, the reaction product, HD, was readily detectable from the high Miller index, stepped surfaces (integrated reaction probability, defined as total desorbed HD flux divided by D_2 flux, is $\sim 10^{-1}$) while HD formation was below the limit of detectability on the Pt(111) low Miller index surface (reaction probability $< 10^{-5}$). Atomic steps at the platinum surface must play a controlling role in dissociating the diatomic molecules. The exchange reaction is first-order in D_2 beam pressure and half-order in H_2 background pressure. This observation indicates that an atom–molecule reaction or possibly an atom–atom reaction is the rate-limiting step in the exchange. The absence of beam kinetic energy dependence of the rate indicates that the molecular adsorption does not require activation energy. The surface is able to store a sufficiently large concentration of atoms which react with the molecules by a two-branch mechanism. The rate constants for this two-branch mechanism were determined under conditions of constant H atom coverage, reducing the bimolecular reaction to a pseudo-first-order reaction. At lower temperatures (< 600°K) the rate constant for the exchange is $k_1 = (2 \pm 1) \times 10^5 \exp(-4.5 \pm 0.5\ kcal/RT)\ sec^{-1}$. The rate determining step appears to be the diffusion of the D_2 molecule on the

surface to a step site where HD is formed via a three-center (atom–molecule) reaction, or via a two-center (atom–atom) reaction subsequent to D_2 dissociation at the step. At higher temperatures (>600°K) the reaction between an adsorbed H atom and an incident D_2 gas molecule competes with the low temperature branch. The rate constant for this branch is $k_2 = (1\pm2) \times 10^2 \exp(-0.6\pm0.3$ kcal/RT) sec^{-1}. The catalyst action of the platinum surface for the exchange reaction is due to its ability to adsorb and dissociate hydrogen molecules with low activation energy and to store atomic hydrogen on the surface thereby converting the gas phase molecule–molecule reaction to an atom–molecule or atom–atom reaction of low activation energy. (auth)

Feed Materials Processing

Refer also to abstract 740.

Radiation Chemistry

Refer also to abstracts 102, 213, 1025, 1028, 1035, 1036, 1063, 1124, 1257, 1512, 1532, and 1546.

107 (AD–767720) RADIATION-INDUCED GRAFTING ON POLYAMIDES. Wilson, J. E. (Bishop Coll., Dallas, Tex. (USA)). Sep 1973. Contract N00014-72-C-0052. 32p. NTIS $3.00.

Earlier work indicated that in the radiation-induced grafting of vinyl monomers on polymeric films, the plasticity of the film being grafted is determined by the Hildebrand solubility parameter of the grafting solution. In the grafting of styrene on nylon film, a sequence of irradiation runs was made at selected volume ratios of styrene/benzene/methanol, all grafting solutions having a constant solubility parameter value of 7.8. A similar sequence of runs grafted pentafluorostyrene on nylon film at constant solubility parameter. Styrene was grafted on polyethylene film in a sequence of four runs using styrene dissolved in methanol, ethanol, 1-propanol, and 1-butanol, each solution having the same solubility parameter of 10.4. A straight-line plot of grafting rate versus volume percent styrene was obtained. (auth)

108 (AD/A-002421) POLYMER/SOLVENT INTERACTION IN THE RADIATION-INDUCED GRAFTING OF VINYL MONOMERS ON POLYMERIC FILMS. Wilson, J. E. (Bishop Coll., Dallas, Tex. (USA)). 4 Nov 1972. Contract N00014-72-C-0052. 47p. NTIS $3.75.

Evidence has been obtained concerning rate effects in the radiation-induced grafting of vinyl monomers on polymeric films resulting from plasticization of the film by the grafting solution, the plasticizing efficiency of the solution being indicated by its Hildebrand solubility parameter. The grafting mechanisms are elucidated by the construction of three-component phase diagrams for the polymer/solvent (1)/solvent (2) grafting systems, using equations based on the Flory-Huggins Theory of polymer/solvent interaction. (GRA)

109 (AEC-CONF-74-465-022) RADIATION-INDUCED GRAFTING ONTO WOOL. Schnautz, N. G.; Du Plessis, T. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Chemistry Div.). 1974. 12p. INIS.

From discussion meeting: Radiation chemistry of the polymers of the Gesellschaft Deutscher Chemiker; Garching/Muenchen, F. R. Germany (23 Oct 1974).

3 figs.; 3 tabs.; 16 refs. With abstract.

The radioinduced graft copolymerization of styrene onto wool in aqueous methanol was studied over a temperature range of 0 to 45°C and a radiation dose rate range of 0.05 to 2.0 Mrad/hr. The rate of grafting was found to obey the classical polymerization equation. Chain transfer to wool was found to play an important role in the grafting process and the molecular weight of the resulting graft copolymer was found to be independent of the irradiation dose. The activation energy of the graft process changed from a value of 4.7 kcal/mole below 19°C to a value of 18.7 kcal/mole above this temperature. This phenomenon is ascribed to the formation of hydrogen-bonded systems between the protic solvent molecules and the protein chain in the wool. (auth)

110 (COO-2217-6) INVESTIGATION OF MOLECULAR MECHANISMS IN PHOTODYNAMIC ACTION AND RADIOBIOLOGY WITH NANOSECOND FLASH PHOTOLYSIS AND PULSE RADIOLYSIS. Progress Report, July 1, 1974–June 30, 1975. Grossweiner, L. I. (Illinois Inst. of Tech., Chicago (USA). Dept. of Physics). 1975. Contract AT(11-1)-2217. 49p. Dep. NTIS $5.50.

Initial mechanisms in the UV photooxidation of aromatic amino acids are being investigated with laser flash photolysis at 265 nm in connection with enzyme inactivation. Aqueous tryptophan (Trp) is photoionized by an efficient monophotonic process, followed by a hitherto unreported pseudo-first order recombination competing with bimolecular e^-/sub aq/ decay and electron scavengers. Measurements of the photoionization quantum efficiency, the aromatic radical extinction coefficients, and the electron decay kinetics are reported. The flash photolysis of N-formylkynurenine (FK) has been studied in connection with its role in "internal" photodynamic action in bovine carbonic anhydrase (BCA). The triplet state of FK oxidizes Trp to the radical formed also by UV photolysis, leading to the FK semiquinone which reacts with oxygen to produce O_2^-. The same FK semiquinone species is formed by radiolytic reduction by e^-/sub aq/ and CO_2^-. A parallel radiolysis study on BCA using radical anions as probes of specific residues has shown that the zinc atom protects against the inactivating attack of e^-/sub aq/ and CO_2^-. Evidence for sensitive aromatic residues in BCA has been found with this technique. Photodynamic damage to biological membranes is being studied with spin label ESR methods. New work is reported on damage to unsaturated lipids sensitized by Eosin based on changes in the temperature-dependence of the spin label rotational correlation time. Preliminary results with diploid yeast membranes (Saccharomyces cerevisiae) show a loosening of the structure accompanying photodynamic inactivation. (auth)

111 (CRN-CNPA-74-14) EFFECTS OF γ RADIATION AND NEUTRONS ON PERHALATES. Hassan, N. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg–1 Univ., 67 (France)). 1974. 70p. (In French). INIS.

The radiolytic reduction of potassium perbromate and periodate and the effects of thermal neutron capture in alkali and ammonium perbromates were investigated. The radiolytic yields $G(-XO_4^-)$, were determined in acid (pH = 1.25) and neutral (pH approximately equal to 7) medium. A reaction mechanism is proposed. The distribution of radiobromine resulting from the neutron irradiation of alkali metal perbromates is the following: Br^- (74%), BrO_3^- (24%), BrO_4^- (1%). In ammonium perbromate an increase of the reduced fraction is observed: Br^- (87%), BrO_3^- (13%), BrO_4^- (0.2%). On thermal annealing bromide is oxidized to bromate, $^{82}Br^-$ ions being oxidized more rapidly then $^{80m}Br^-$ ions. (FR)

112 (HMI-B-156) ELECTRON MIGRATION IN LIQUIDS AND GLASSES (A REVIEW). Schmidt, W. F. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Oct 1974. 91p. Dep. NTIS (US Sales Only) $7.75.

The following topics are covered: experimental methods (mobility measurements and conduction energy levels), electrons in non-polar liquids, electron mobility in polar liquids, anionic mobility, electron mobility in glasses, and models for electron transport. (LK)

113 (IRI-133-74-06) IONIZATION IN THE TRACK OF A HIGH-ENERGY ELECTRON IN HYDROCARBON LIQUIDS; STUDY OF POSITIVE AND NEGATIVE ION SCAVENGING USING NANOSECOND PULSE RADIOLYSIS. Zador, E.; Warman, J.; Hummel, A. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1974. 46p. Dep. NTIS (US Sales Only). $5.50.

The lifetime distribution of the charged particles in the track of a high-energy electron in cyclohexane and isooctane has been considered. Results on the decay of biphenyl ions in solutions of biphenyl obtained by means of pulse radiolysis with nanosecond time resolution have been compared with lifetime distributions calculated from the concentration dependence of the steady state scavenging, using recently determined absolute rate constants for reaction of excess electrons and mobilities of the charged species. The discrepancy is relatively small for cyclohexane but large for isooctane. It is concluded that the scavengers considerably affect the initial spatial distribution of the charged species in the track. The kinetics of the reaction of the positive species in cyclohexane and isooctane with biphenyl, TMPD, and pyrene has been considered. It has been concluded that the mobile positive species in cyclohexane reacts with pyrene with a rate constant of 5×10^{11} M^{-1} s^{-1}, and has a lifetime of 50 nsec. In isooctane no evidence for the existence of a mobile positive species has been obtained. (auth)

114 (N-74-22802) RADIATION CHEMISTRY OF MONOMERS AND POLYMERS. Final Report. Wilson, J. E. (Bishop Coll., Dallas, Tex. (USA)). 1973. 95p. (NASA-CR-138255). NTIS $7.75.

Types and sources of radiation, radiation effects on matter, short-term chemical effects of radiation absorption, and radiochemistry of small molecules are discussed. Radiolytic polymerization in homogeneous systems and in the solid state are described, along with radiation-induced polymerization in thermosetting, polyester, and emulsion systems. Crosslinking versus scission in irradiated polymers and radiolytic grafting of monomers on polymeric films are also considered. (STAR)

115 (RFP-2354) RADIATION EFFECTS ON ION-EXCHANGE RESINS. Part II. Gamma Irradiation of Dowex 1. Kazanjian, A. R.; Horrell, D. R. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 27 Feb 1975. Contract AT(29-1)-1106. 12p. Dep. NTIS $4.00.

The effects were determined of gamma radiation on the anion exchange resin, Dowex 1. Part I on Dowex® 50W was reported May 10, 1974. The exchange capacity (both strong and weak base), moisture content, radiolysis products, and physical deterioration of the resin were analyzed after irradiation with doses up to 6.9 x 10^8 rads. The resin capacity decreased approximately 50 percent after a radiation dose of 4 x 10^8 rads. Resin irradiated, when air dried in the nitrate form, showed more stability than resin irradiated in 7N nitric acid (HNO_3), which in turn showed more stability than resin irradiated when air dried in the chloride form. Radiation decreased the strong base capacity to a greater extent than the total capacity. The result indicates that some of the quarternary ammonium groups were transformed to secondary and tertiary amine groups that have weak base ion-exchange capability. (auth)

116 STRENGTHENING OF ETHYLENE AND VINYL ACETATE COPOLYMER FILMS BY MEANS OF SMALL GAMMA RADIATION DOSES. Palei, I. V.; Krivonosov, A. I.; Kurzhunkova, M. S.; Il'vako, E. V.; Sokolova, E. A.; Akutin, M. S. Plast. Massy; No. 7, 16-17(1974). (In Russian).

This study deals with the modifying effect of small doses of gamma radiation on the properties of copolymers of ethylene containing vinyl acetate, and with a study of the features of this process in comparison with low-density polyethylene. On the basis of the data which were obtained it is concluded that the effect of small doses of gamma radiation leads to radiation cross-linking of the copolymers at 2.5 to 10 Mrads. In this case an improvement is attained in the strength, thermomechanical and thermophysical characteristics of the copolymer. The transparency of the film in the visible region of the spectra does not change. The melting temperature does not change significantly on irradiation at 2.5 to 10 Mrad. (tr-auth)

117 ELECTRON SPIN RESONANCE OF TRAPPED RADICALS AND THE PHOTOINDUCED RADICAL CONVERSION IN γ-IRRADIATED 3-METHYLPENTANE GLASSES AT 77°K. Lin, D. P. (National Tsing Hua Univ., Hsinchu, Taiwan). J. Chin. Chem. Soc. (Taiwan); 21: No. 4, 201-210(Dec 1974).

Studies on the isotropic hyperfine splitting constants of protiated and deuterated 3-methylpentyl radicals produced by γ-rays accompanied with the radical yield determinations reveal that the radicals are distributed in clusters in the matrix. A tentative mechanism with the migration of positive hole is proposed for the formation of UV-induced new radicals following γ-irradiation in 3-methylpentane glasses at 77°K; and to account for all the experimental observation. (auth)

118 GAMMA-RAY-INDUCED GASEOUS PHASE POLYMERIZATION AND COPOLYMERIZATION OF VINYL MONOMERS IN BAGASSE. Wang, U. P. (Union Industrial Research Inst., Hsinchu, Taiwan). J. Chin. Chem. Soc. (Taiwan); 21: No. 4, 255-261(Dec 1974).

Gamma-ray induced gaseous phase in situ polymerization of vinyl chloride and copolymerization of vinyl chloride with vinyl acetate in bagasse have been investigated and discussed. The prepared bagasse-plastic combinations were not improved of its mechanical strength owing to the deposited PVC powder and the low copolymer loading in bagasse-board. The viscosity average molecular weight of PVC formed in bagasse-board was found to be slightly higher than that of PVC formed in the in situ liquid polymerization system. No graft reaction of PVC onto bagasse cellulose was observed, while low grade of graft reaction was confirmed with PVC-PVAc copolymer system. (auth)

119 METAL SOLUTIONS IN AMINES AND ETHERS. Dye, J. L. pp 77-95 of Electrons in Fluids. Jortner, J.; Kestner, N. R. New York; Springer-Verlag (1973).

The most recent studies of metal solutions in amines and ethers are reviewed. The metal solubility can be greatly enhanced by the addition of "crown" and "cryptate" to the solution. Studies are also presented which provide evidence for the existence of the monomer (M) and alkali anion (M^-) species. Finally a general equilibrium scheme for all species is presented and the influence of the solvent is discussed. (auth)

120 RADIATION-INDUCED CONDUCTIVITY IN ORGANIC SOLIDS. Frankevich, E. L.; Yakovlev, B. S. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 6: No. 5, 281-296(Dec 1974).

The radiation-induced conductivity of non-polar organic solids is discussed, attention being focused mainly on solid hydrocarbons. Three types of electrical properties and their changes under irradiation are considered: an increase in the electrical conductivity (σ_r) of solids directly under irradiation, the appearance of photoconductivity (σ_f) due to the action of the irradiation, and an increase in the conductivity when irradiated specimens are warmed up. The experimental results on σ_r are compared with the predictions of the simple Rose-Fowler model which describes the main features of radiation-induced conductivity but fails at low temperatures where it predicts too high a level of trap filling. The adequate description of σ_r is shown to follow a simple model where a single trapping and recombination level is involved. The main difference in the current carrier generation between organic solids and inorganic semiconductors consists in the spatially inhomogeneous generation of electrons and holes for the former. When an organic material with high density of traps is irradiated, electron-ion pairs can be stabilized by trapping. This can result in all electrons (with $G_e \approx 3$) taking part in the conductivity current through the specimen excited by irradiation pulses but the sample becomes polarized due to their trapping. The superposition of stabilized pairs in continuous irradiation permits them to be involved in the conductivity process in spite of the inability of electrons to leave their "own" ions in any single pair. The radiation-induced high voltage polarization phenomena which are due to the spatially limited motion of charges in molecular solids are described. The radiation-induced photoconductivity is caused by the excitation by photons of trapped current carriers. Methods are described which permit monitoring of the stabilized charges and the generation of new traps by measuring the photoconductivity. The spectral response of σ_f gives evidence of a narrow energy distribution of the traps which exist in pure molecular solids. (auth)

121 LOCALIZED ELECTRONS IN MOLECULAR AGGREGATES. Funabashi, K.; Cheng, I. Y. (Notre Dame Div., IN). Int. J. Radiat. Phys. Chem.; 6: No. 5, 497-514(Dec 1974).

Electron localization in molecular aggregates is related to two independent physical concepts. One is the non-periodicity of the system and the other is the dynamic concept of electron-phonon interaction. These two concepts are separately investigated in terms of one-dimensional models. The effect of localized states on the quasi-free state, V_0, is also discussed. (auth)

122 TRAPPED ELECTRONS AND HYDROGEN FORMATION MECHANISM IN γ-IRRADIATED GLASSY ALCOHOLS AND 2-METHYLTETRAHYDROFURAN. Teply, J. (Ustav Jaderneho Vyzkumu, Rez, Czechoslovakia). Int. J. Radiat. Phys. Chem.; 6: No. 5, 379-392(Dec 1974).

The electrons trapped in glassy alcohols at 77°K are characterized by an optical absorption spectrum, which is composed of partial individual spectra differing only very little from each other. The kinetics of photobleaching under these circumstances is analyzed. The quantum yield is low ($\leq 10^{-1}$) and increases with the photon energy when it surpasses the value of about 2.3 eV corresponding to the absorption maximum. The kinetics of photobleaching is not significantly affected by the presence of various solutes, while the kinetics of the thermal decay of trapped electrons is. The trapped electrons excited by light are converted into alkoxy anions and H atoms which further abstract mainly from alkyl groups. The trapped electrons migrating at higher temperature react similarly to solvated electrons. Their reaction with the protonated alcohols produces hydrogen atoms which do not abstract; this results in lower hydrogen yields than those obtained after photobleaching. Besides the reaction of trapped electrons the reaction of hydrogen atoms formed independently of trapped electrons and the formation of unscavengeable hydrogen participate in the total hydrogen yield. A model of the trapped electron and of its reactions is suggested. In methyltetrahydrofuran the electrons are detrapped by light, their kinetics of photobleaching being significantly affected by electron scavengers. Either the detrapped electrons are retrapped or they react with the radicals or scavengers present. The trapped electrons are responsible for hydrogen formation only to a very small extent. The exact hydrogen formation mechanism is still unknown. (auth)

123 ELECTRON SCAVENGING AT VERY LOW TEMPERATURE. Higashimura, T. (Kyoto Univ., Kumatori, Osaka). Int. J. Radiat. Phys. Chem.; 6: No. 5, 393-400(Dec 1974).

Results of electron scavenging experiments for gamma irradiation at 4°K are reviewed. An anomalous increase in the scavenging efficiency at 4°K is discussed. Intermediate anions which have very short lifetimes at usual temperatures are very stable at 4°K. As an example of these anions, the optical absorption spectrum of the benzyl chloride anion is described. (auth)

124 EFFECT OF SOLVENT ON RADIOINDUCED ION GRAFT POLYMERIZATION. Kabanov, V. Ya.; Sidorova, L. P. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. B; 17: No. 1, 31-33(Jan 1975). (In Russian).

The effect of the solvent on the radiation-induced grafting of vinyl-n-butyl ether to polyethylene was studied. The six solvents studied were cyclohexane, 1,2-dichloroethane, chloromethylene, nitrobenzene, tetrahydrofuran, and pyridine. Films of polyethylene were immersed in solutions of the monomer and exposed to ^{60}Co γ radiation at a dose rate of 13.2 rad/sec. The radiation grafting yield was determined and the results obtained are tabulated. Both low density and high density polyethylene films were used. The results show that radiation grafting in moist systems and in electron acceptor systems is quite low. Radiation grafting in electron donor solvents is strongly inhibited. In solution of 1,2-dichloroethane grafting occurs in all conditions. Grafting in chlorinated hydrocarbons is significant. These studies indicate that in cases of radiation-induced ion grafting the reaction rate and graft radiation yield is very sensitive to the nature of the solvent. (JSR)

125 RADIOINDUCED ANION GRAFT POLYMERIZATION OF ACRYLONITRILE AND 4-VINYLPYRIDINE TO POLYETHYLENE AND POLY(TETRAFLUOROETHYLENE). Kabanov, V. Ya.; Aliev, R. E. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. B; 17: No. 1, 29-31(Jan 1975). (In Russian).

The radiation grafting of acrylonitrile (AN) and 4-vinylpyridine (VP) to low-density polyethylene and polytetrafluoroethylene was studied under conditions of extreme dessication of all systems. The γ-induced grafting was done on films and the percent of grafting was determined from the ratio to the weight of the original film. Radiation grafting of the dry AN and VP proceeds with a much higher rate and radiation yield than monomers dried under the normal conditions. The strong effect of traces of water on the radiation grafting indicates that the grafting in these conditions occurred by an anion mechanism. Analysis of the ir spectra of the copolymers obtained from dessicated monomers showed no difference from the ir spectra of polymers obtained under conditions of radical and ion mechanisms. The use of the anion mechanism would increase the rate and radiation chemical yield of grafts and allow the grafting to be made at lower radiation doses, which would be of considerable advantage in the grafting of materials with low radiation stability. (JSR)

126 RADIATION YIELD OF STABILIZED REACTION CENTERS IN FLUOROHYDROCARBONS OF DIFFERENT MOLECULAR STRUCTURE. Kozlov, V. T.; Lanin, S. N.; Kashevskaya, N. G.; Khan, A. A.; Soldatenko, A. T. (Scientific Inst. of the Rubber Industry, Moscow). Vysokomol. Soedin., Ser. B; 17: No. 1, 3-6(Jan 1975). (In Russian).

The paramagnetic centers, stabilized under conditions of low-temperature (77°K) gamma radiolysis of fluorohydrocarbon elastomers, were studied by the EPR method using the bleaching effect of light at $\lambda \approx 6000$ to 2200 Å. The free radical yield was calculated from the linear part of the curve of radical accumulation in the samples at irradiation doses from 1 to 80 Mrad. The paramagnetic centers have a significant light sensitivity. During bleaching neutralization or redistribution of the charges occurs. In the dose interval from 1 to 20 Mrad there is significant deviation from linearity on the accumulation curve of paramagnetic centers. At higher dose the size of the ratio of the quantity of light-sensitive and non-light-sensitive paramagnetic centers decreases. The probability of radical decomposition is a function of the structure of the elastomer and increases with decrease of the fluorine content. (JSR)

127 RADIATION-INDUCED EXCITATION OF LUMINESCENT ORGANIC SOLUTES IN AQUEOUS MEDIA. Steen, H. B.; Strand, O. (Norsk Hydro Institutt for Kreftforskning, Oslo). Int. J. Radiat. Phys. Chem.; 6: No. 5, 447-464(Dec 1974).

Studies of the radioluminescence of various aromatic substances as well as of purines and pyrimidines are reviewed. Most experiments were on polar solutions and glasses between 77 and 300°K. The luminescence was studied during x-irradiation and subsequent to it. Thus, both fluorescence and phosphorescence were observed together with a slow "afterglow" and thermoluminescence. The radioluminescence of these systems arose almost exclusively from the solute. Luminescence caused by solvent to solute energy transfer was negligible. However, in molecules containing aliphatic groups some of the excitation of these groups appeared to be transferred to the triplet manifold of the chromophore. The results were compared with corresponding data obtained upon exposure with non-ionizing UV light under identical conditions. The emission spectra and the phosphorescence decay kinetics demonstrated that x-irradiation produces the same radiative levels as does UV exposure. At low temperatures the phosphorescence-to-fluorescence ratio was considerably enhanced with the ionizing radiation, the main reason apparently being that a large fraction of the radioluminescence at low temperatures is due to excitation resulting from geminate recombination between solute cations and electrons. On the basis of the temperature dependence of the radioluminescence of indole dissolved in ethylene glycol–water mixtures as well as the effect of electron scavengers on this luminescence, it was estimated that at 77°K 80 to 85 percent of the solute luminescence is due to recombination, the remainder being excitation directly from the ground state. The triplet to singlet ratio (T/S) for the recombination process below 150°K was 1.2, whereas for the direct excitation T/S = 0.2. The lifetime of the ion pair prior to recombination was between 2.5×10^{-8} and 5×10^{-5} s, indicating that the electrons recombine from shallow traps or from charge transfer to solvent-like states rather than from the "free" state. Excitation by recombination fell rapidly above 150°K so that in liquid solution above 240°K direct excitation was the only mode of excitation. (auth)

128 THERMOLUMINESCENCE OF GAMMA-IRRADIATED HYDROCARBON GLASSES. Brocklehurst, B. (Univ. of Sheffield, Eng.). Int. J. Radiat. Phys. Chem.; 6: No. 5, 483-495 (Dec 1974).

Thermoluminescence occurs when ions are released by heating irradiated alkane glasses. Calculated energies of recombination of aromatic hydrocarbon radical ions are in agreement with the observation that both singlet and triplet states can be excited; the ratio of fluorescence to phosphorescence and the recombination distance are discussed. Emission from aromatic radicals is observed in some cases: emission from olefins has yet to be assigned. The form of the "glow curves" is interpreted in terms of the separations of trapped ion pairs; when these are large, scavengers are more effective and dimer cations may be formed; the latter give excimers on neutralization. Some work on o-terphenyl, cumene and squalane matrices is described. (auth)

129 RADIATION CHEMICAL DECOMPOSITION OF BIOLOGICALLY RESISTANT HARMFUL SUBSTANCES IN WASTE-WATERS. Gilbert, E.; Guesten, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). KFK Nachr.; 6: No. 3, 10-13(1974). (In German).

Concepts of radiation chemical waste water treatment, radiation chemical model investigations on chlorated phenols and dye waste waters, region of application, technology and costs are discussed. (GE)

130 USE OF 5-IODODEOXYURIDINE (5-IUdR) FOR RADIATION DOSIMETRY. Lohmann, W. (Giessen Univ. (F. R. Germany). Inst. fuer Biophysik; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Abt. fuer Biophysikalische Chemie). Radiat. Environ. Biophys.; 11: No. 3, 203-207(Oct 1974).

^{60}Co-γ-irradiation of an aqueous 0.15 mM 5-iododeoxyuridine (5-IUdR) solution results in an I-absorption band at 226 nm. The absorbance of this band, as obtained from difference spectra (irradiated vs. unirradiated sample), increases linearly with dose between 200 and 12,000 rad. Smaller doses cannot be detected experimentally; at higher doses, saturation is reached due to the limited amount of iodine present in 6-IUdR. Because of the linear OD-dose relationship this system might be used for radiation dosimetry. (auth)

131 KINETICS OF RADIOINDUCED POLYMERIZATION OF METHYL METHACRYLATE ADSORBED ON SILICA GEL. Kritskaya, D. A.; Ponomarev, A. N. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. B; 17: No. 1, 67-70(Jan 1975). (In Russian).

The radiation-induced polymerization of MMA was studied to determine if there is a relation between the heat of adsorption and the specific rate of polymerization and to evaluate the magnitude of the polymerization rate constant. The amount of MMA adsorbed on the silica gel, the heat released during adsorption, the length of γ irradiation of the system, the rate of heat release during the irradiation and after the termination of the irradiation, and the amount of polymer formed were measured. The results showed that after the start of the irradiation the heat release increased, approached a constant value, and after the irradiation fell to zero in the course of several minutes. The experimental data indicated that the break in the chain during polymerization of adsorbed MMA is a linear process taking place through active centers. There was also a linear dependence of the rate of polymerization on the dose rate. It was also shown experimentally that the greater the heat of adsorption, the less the specific rate of radiation grafting. The rate constant for the reaction was calculated for monolayers and thick layers of the MMA. (JSR)

132 SOME PROPERTIES OF TRAPPED ELECTRONS, RADICALS AND H ATOMS IN GLASSY HYDROCARBONS. Wil-

lard, J. E. (Univ. of Wisconsin, Madison). Int. J. Radiat. Phys. Chem.; 6: No. 5, 325-342(Dec 1974).

Studies made of the properties and reactions of electrons, radicals, and hydrogen atoms produced in organic glasses at 77°K and below by γ-radiolysis and photolysis are reviewed. The goal of the work was to advance understanding of the mechanisms of formation, trapping and reaction of these intermediates. Optical and ESR spectrometry, electrical conductivity, and differential thermal analysis were the techniques of analysis. The work has included selective wavelength bleaching of the ir spectra of trapped electrons in organic glasses; investigation of electron capture by free radicals and subsequent photodetachment from the carbanions; and determination of the heats of reaction of trapped electrons, ions and radicals when the glass is photobleached or warmed to permit diffusion. The effects of γ dose on the yield of trapped electrons, and of light intensity on the photobleaching of the e_t^- are considered. The data on electrons are discussed with respect to the evidence which they give on the electron trapping mechanism, the variety of trap depths, electron tunneling and multiple retrapping without neutralization. Evidence is given on the fraction of the radicals produced by γ-irradiation of a hydrocarbon glass which decay by random diffusive encounters as compared to intraspur reaction. CH_3 radicals produced from methyl halides in 3-methylpentane glass by dissociative electron capture are shown to decay by abstraction of H from the C_6H_{14} molecules, whereas in C_6D_{14} the decay is attributable to geminate recombination ($CH_3 + I^- \rightarrow CH_3I^-$). An example is given of the use of radical decay kinetics in hydrocarbon glasses to determine diffusion coefficients of small molecules which can react with the radicals. Hydrogen atoms are shown to be absent in the radiolysis of glassy hydrocarbons. These and related observations are discussed with respect to the information they give on the properties of the intermediates and on the total radiolytic process in the glasses. (auth)

133 RADIATION DAMAGE IN SOME PLATINUM(IV) COMPLEXES PRODUCED DURING SOFT X-RAY PHOTOELECTRON SPECTROSCOPIC STUDIES. Burroughs, P.; Hamnett, A.; McGilp J. F.; Orchard, A. F. (Oxford Univ.). J. Chem. Soc., Faraday Trans., II; 71: No. 1, 177-187(1975).

The results of a study of the reduction of some platinum(IV) compounds during the course of x-ray photoelectron measurements are presented. All the compounds investigated suffered reduction though the observed rates varied considerably. Kinetic analysis of the peak intensities in the x-ray photoelectron spectra reveal that the reduction process is invariably first order, and a model is proposed to account for this finding. Platinum(II) compounds studied were stable to x-radiation. (auth)

134 PULSE RADIOLYSIS AND POLAROGRAPHY. Reactions of Oligomer and Polymer Radicals of Polyethylene Oxide at the Mercury Drop Electrode. Sellers, R. M.; Bansal, K. M.; Janata, E.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie). Ber. Bunsenges. Phys. Chem.; 78: No. 10, 1085-1090(Oct 1974).

The formation of polyethylene oxide (PEO) macroradicals of various chain lengths by the attack of OH radicals on dissolved PEO was initiated by a pulse of 12-MeV electrons and the polarographic currents of these macroradicals were recorded at various potentials. Measurements of the differential capacity of the double layer were also carried out to study the adsorption of polyethylene oxide at the mercury electrode. Macroradicals (chain length 45-230) were found to be more easily oxidized than oligomer radicals (chain length 2 and 4). The polarographic currents of the macroradicals were found to be produced solely by adsorbed macroradicals at potentials between −0.2 and −1.6 V vs. saturated calomel electrode, where polyethylene oxide is strongly adsorbed. These radicals were produced by OH attack on adsorbed macromolecules. Beyond that potential range, mobile macroradicals produced in solution can react at the electrode. The PEO coated electrode was also used to measure the polarograms of various free radicals produced by attack of hydrated electrons on various solutes. The electron adducts of uracil and fluorouracil exhibit a broad anodic wave indicating their strong reducing properties. The electron adduct of orotic acid was found to be a weaker reducing agent. (auth)

135 TIME-RESOLVED PHOTOBLEACHING OF SOLVATED ELECTRON ABSORPTION BANDS. Walker, D. C.; May, R. (British Columbia Univ., Vancouver, Canada). Int. J. Radiat. Phys. Chem.; 6: No. 5, 345-377(Dec 1974).

A review is given of studies on the time resolution of photobleaching of solvated (or trapped) electrons following excitation by a 20 ns Q-switched ruby laser pulse. Various transient and permanent bleaching effects are shown to evolve on distinct time scales ranging from nanoseconds to tenths-of-a-second. The systems studied were: photolytically produced hydrated electrons in liquid water at room temperature, γ-induced trapped electrons in a variety of aqueous and organic glasses at 77°K and γ- or additively produced F-center electrons in KBr and KI crystals at room temperature and 77°K. A number of effects were observed which are pertinent to a basic understanding of the nature and origin of the optical absorption bands of solvated electrons. They are also pertinent to the interpretations to be placed on photobleaching and photoconductivity data under "steady-state", low intensity illumination. In addition to transient and immediate bleaching effects arising directly from photoexcitation, there are important contributions to the overall net bleaching of trapped electrons in glasses which take place up to 1s after the light pulse. These apparently arise from incipient but latent electron states or from a delayed response of the medium to multiple excitations (and de-excitation or retrapping) of e_t^-. In aqueous glasses transient species which absorb in the I. R. (1152 nm) are observed to arise from photoexcitation of e_t^- at 694 nm. Variations of the integrated Beer-Lambert absorption law are presented for use with high light intensities. The appropriate equations are developed to show how the absorbance at a monitoring wavelength changes as a result of concurrent intense illumination at another wavelength. It is also shown that for absorption bands which are heterogeneously broadened, due to the presence of underlying discrete bands, the extinction coefficients will be larger than those calculated on the basis of the band being homogeneous. When very narrow discrete bands exist the absorption spectrum observed is merely the profile of the population distribution of traps. (auth)

136 ONE-ELECTRON OXIDATION OF ODD-VALENT METAL IONS IN SOLUTION. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Phys. Chem.; 79: No. 9, 865-868(24 Apr 1975).

The fast-reaction technique of pulse radiolysis and kinetic absorption spectrophotometry was used to generate odd-valent metal ions in neutral aqueous solution, and study their one-electron oxidation reactions. Using the sulfate and perchlorate salts, the M^{2+} ions were reduced to the M^+ ions by e^-/sub aq/. The Zn^+, Co^+, Cd^+, Pb^+, Ni^+, as well as Cr^{2+} and Tl^0, odd-valent metal ions were produced. The one-electron oxidation of these odd-valent metal ions was studied in the presence of various electron acceptors A (including phenones, dyes, and quinones) whose two-electron redox potentials E^{01} (V, at pH 7.0, 25°) are known. The percentage efficiency of the electron transfer reaction $M^+ + A$ yields $M^{2+} + \cdot A^-$ was found to be dependent upon the E^{01} values of the acceptors. Titration-type curves are obtained, and from the midpoint (50 percent electron transfer) kinetic potentials for the M^+ parallel M^{2+} redox couples were derived. These potentials are not the thermodynamic values since the electron transfer processes followed were found to be irreversible, under the experimental conditions used. The results show that the reducing power of the odd-valent metal ions decreased in the order Zn^+ greater than or equal to Co^+ greater than or equal to Cd^+ greater than Tl^0 greater than Pb^+ greater than Ni^+ greater than Cr^{2+}. (auth)

137 REACTION PRODUCTS AND STORED ENERGY RELEASED FROM IRRADIATED SODIUM CHLORIDE BY DISSOLUTION AND BY HEATING. Jenks, G. H. (Oak Ridge National Lab., TN); Sonder, E.; Bopp, C. D.; Walton, J. R.; Lindenbaum, S. J. Phys. Chem.; 79: No. 9, 871-875(24 Apr 1975).

As a part of a study of energy stored in irradiated NaCl, it was found that heats evolved on aqueous dissolution of irradiated samples were consistently about 50 percent lower than the stored energy released during heating of the samples. It seemed likely that these differences could be explained in terms of the reactions that take place during dissolution; therefore, a combination of measurements was used to help identify such reactions. Parameters determined included heat release on thermal bleaching and on dissolution of irradiated samples, identity and quantity of gases evolved during aqueous dissolution, and concentrations of hypochlorite ion in solutions of irradiated salt. Analyses of experimental data and of other information indicated that during dissolution a reaction occurs between irradiation-activated NaCl molecules and H_2O, in which the principal solution products are OCl^-, HOCl, and H_2 in addition to Na^+ and Cl^-. The results indicated that the energy per radiation-activated molecule of NaCl is approximately equal to the heat of formation of NaCl from the elements. The results confirm that heat-of-solution as well as drop calorimetry can be used to measure stored energy in irradiated NaCl and, probably, other solids. However, it is essential that the species formed by dissolution of the displaced atoms be known in order to interpret the solution calorimeter data correctly. (auth)

138 ELECTRON IMPACT INVESTIGATION OF 1,1,2,2-TETRAFLUOROCYCLOBUTANE. Ravishankara, A. R.; Hanrahan,

R. J. (Univ. of Florida, Gainesville). J. Phys. Chem.; 79: No. 9, 876-881(24 Apr 1975).

An investigation has been made of the fragmentation of 1,1,2,2-tetrafluorocyclobutane under electron bombardment in a Bendix time-of-flight mass spectrometer. Using the Fox retarding potential difference technique, measurements were made of the appearance potentials of major ionic fragments including $C_2H_2F_2^+$ (12.15 V), $C_2F_4^+$ (12.60 V), $C_2H_3^+$ (13.15 V), and $C_3H_4F^+$ (12.85 V). From these results it is found that DELTA H⁰/sub f/ for the $C_3H_4F^+$ ion is less than or equal to +207 kcal/mol and DELTA H⁰/sub f/ for parent c-$C_4H_4F_4$ is greater than or equal to -202 kcal/mol with good agreement between three independent routes of calculation. For the c-$C_4H_4F_3^+$ ion an approximate appearance potential of 13.5 V is found; a reasonable interpretation of this result requires that the conjugate product is F^- rather than the neutral atom. A rather detailed argument suggests that the symmetrical rupture of the molecule into $C_2H_2F_2^+$ plus $C_2H_2F_2$ is a sequential process with the sum of the energy of breaking two nonequivalent C–C bonds (between two CF_2 and two CH_2 groups) equal to 126 kcal/mol, while the nonsymmetrical rupture into $C_2H_3^+$ and C_2F_4 is concerted, and the energy of breaking each of two equivalent C–C bonds between CF_2 and CH_2 groups is 61 kcal/mol. (auth)

139 PROTON BEAM RADIOLYSIS OF MATRIX SAMPLES. A New Technique for Infrared Spectroscopic Study of Charged Molecular Intermediates. Allen, R. O.; Grzybowski, J. M.; Andrews, L. (Univ. of Virginia, Charlottesville). J. Phys. Chem.; 79: No. 9, 898-904(24 Apr 1975).

A radio-frequency ion source capable of delivering 2.0-keV protons has been mated with a matrix-isolation apparatus and techniques for irradiating matrix samples with protons have been developed. Proton beam radiolysis of Ar/CCl_4 equals 400/1 samples during 15°K deposition has produced a number of new infrared absorptions. Nernst glower photolysis of the matrix sample through a glass filter passing 500–3000-nm radiation, which is capable of releasing chemically trapped electrons, markedly reduced infrared absorptions at 1020, 927, 502, 374, and 290 cm^{-1}. These bands were assigned to isolated cations owing to their disappearance following the addition of thermal electrons to the sample. The chemical fate of the bombarding proton was also observed by this technique. (auth)

140 INFRARED SPECTRA OF THE MOLECULAR IONS AND RADICALS PRODUCED BY PROTON RADIOLYSIS OF CARBON TETRACHLORIDE IN ARGON DURING CONDENSATION AT 15°K. Andrews, L.; Grzybowski, J. M.; Allen, R. O. (Univ. of Virginia, Charlottesville). J. Phys. Chem.; 79: No. 9, 904-912 (24 Apr 1975).

Samples of CCl_4 and its carbon-13- or bromine-substituted counterparts at high dilution in argon were deposited at 15°K during simultaneous 2.0-keV proton beam irradiation. New infrared absorptions at 1037, 1020, 927, 898, 746, 502, 374, 290, and 242 cm^{-1} are attributed to CCl_4 radiolysis products and ion-molecule reaction products. The 898- and 746-cm^{-1} bands are due, respectively, to the CCl_3 and CCl_2 chemical intermediates. The 1020-, 927-, 502-, 374-, and 290-cm^{-1} bands, which disappear upon photobleaching and neutralization with thermal electrons, are assigned to the matrix-isolated positive molecular ions CCl_3^+, CCl_2^+, Cl_2^+, $Cl_2CCl_2^+$, and Cl_4^+, respectively. The 242-cm^{-1} absorption is likely due to Cl_3^- perturbed by a large cation. The 1037-cm^{-1} band is due to a CCl_3^+ vibration in an electrically neutral species, presumably $CCl_3^+Cl^-$. The fate of the bombarding proton is demonstrated by the observation of $CHCl_3$ and HCl_2^-, and in deuteron experiments, by the appearance of $CDCl_3$ and DCl_2^-. (auth)

141 RADIOLYSIS OF H_2O AND D_2O BETWEEN 0 AND 300°. Jha, K. N.; Ryan, T. G.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 79: No. 9, 868-870(24 Apr 1975).

The gamma radiolysis yield of fluoride ion from millimolar solutions of sulfur hexafluoride at 23°C was G(F^-) equals 16.0 ± 0.6 in H_2O and 18.6 ± 0.6 in D_2O. One scavenged electron ultimately gave rise to six fluoride ions, so the above values correspond to G(e^-/sub solv/)/sub fl/ equals 2.7 ± 0.1 in H_2O and 3.1 ± 0.1 in D_2O. The scavenging yield increased with increase in temperature up to 300°C and values obtained in D_2O were persistently about 0.5 G units larger than those in H_2O. At 300°C, G(F^-)/6 equals 4.8 ± 0.2 in H_2O and 5.3 ± 0.2 in D_2O. Similar results were obtained at 23°C with nitrous oxide, and the difference in the scavenging yields in D_2O and H_2O persisted up to high scavenger concentrations. The larger yields in D_2O were tentatively attributed to an isotope effect in the total ionization yield, in addition to the previously suggested isotope effect on the ranges of the secondary electrons. Absorption coefficients are reported for sulfur hexafluoride in H_2O and D_2O at temperatures up to 300°C. (auth)

142 NF_3^+ RADICAL CATION. Electron Spin Resonance Studies of Radiation Effects in NF_4^+ Salts. Mishra, S. P.; Symons, M. C. R.; Christe, K. O.; Wilson, R. D.; Wagner, R. I. (Univ. of Leicester, Eng.). Inorg. Chem.; 14: No. 5, 1103-1106(May 1975).

Exposure of $NF_4^+AsF_6^-$ and $NF_4^+SbF_6^- \cdot 0.8SbF_5$ to ^{60}Co gamma rays at 77°K gave two paramagnetic centers, one of which is shown by ESR spectroscopy to contain one nitrogen atom and three equivalent fluorine atoms. Based on its magnetic properties it is identified as pyramidal NF_3^+, a novel radical cation. The other center exhibits strong interaction of the electron with two fluorine atoms, weaker interaction with the antimony or arsenic central atom, and small interaction with several other fluorine atoms. It is tentatively assigned to the electron-loss species AsF_6^-, SbF_6^-, or $Sb_2F_{11}^-$ with the unpaired electron largely confined to two fluorine ligands. Irradiation of $NF_4^+BF_4^-$ did not result in well-defined magnetic centers. An improved synthesis of $NF_4^+BF_4^-$ is reported. (auth)

143 ASPECTS OF ENERGY LEVEL STRUCTURE AND MOBILITIES OF ELECTRONS IN ORGANIC GLASSES. Kevan, L. (Wayne State Univ., Detroit). Int. J. Radiat. Phys. Chem.; 6: No. 5, 297-324(Dec 1974).

Experimental and theoretical aspects of the energy level structure and mobilities of electrons in organic glasses are reviewed. Attention is focused upon trends with matrix polarity. The experimental picture of the energy levels associated with trapped electrons is deduced from the wavelength and temperature dependence of photoconductivity and photobleaching experiments. A reasonably successful theoretical model for the energy level structure, based on a semicontinuum potential incorporating both short-range charge dipole interactions and long-range polarization interactions, is described and compared with experiment. The semicontinuum model is extended to describe successfully the photoionization process in terms of a bound-free transition. Finally, the conduction electron state is considered. The temperature dependence of the electron mobility suggests that a hopping mechanism is dominant in the glass. Comparison of the mobility in glass and liquid phases indicates that the conduction mechanism may change to one dominated by trapping near room temperature. (auth)

144 SOME IONIC REACTIONS IN FROZEN, ORGANIC MATRICES. Kroh, J.; Mayer, J. (Politechnika Lodzka, Poland). Int. J. Radiat. Phys. Chem.; 6: No. 5, 423-445(Dec 1974).

The radiothermoluminescence (RTL) spectra of organic frozen compounds such as methanol, acetone and several hydrocarbons are presented and discussed. Some evidence concerning the negative species responsible for RTL emission and the mechanism of excited-state formation is given. A satisfactory correlation between the temperature of RTL peaks and phase transition points has been found for the methanol–water system as well as for acetone. Additional experimental results are provided concerning the tunnelling hypothesis as a best approach to the kinetics of electron decay in 3-MP glass in the presence of biphenyl and for isothermal radioluminescence (IRL) decay observed at 77°K in such systems as acetone, ethyl acetate and methylcyclohexane. The temperature and viscosity effects on electron decay in organic glasses are pointed out. (auth)

145 KINETIC STUDY OF THE DELAYED ISOTHERMAL LUMINESCENCE OF ORGANIC GLASSES IRRADIATED BY PULSED ELECTRONS. Cordier, P.; Delouis, J. F.; Kieffer, F.; Lapersonne, C.; Rigaut, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physico-Chimie des Rayonnements). Compt. Rend., Ser. C; 279: No. 14, 589-591(30 Sep 1974). (In French).

Delayed isothermal fluorescence kinetics of biphenyl in methylcyclohexane solution was studied at 77°K by pulsed radiolysis. The reaction kinetics follows the same law in the time range 10^{-6} to 10^3s. (FR)

Radiochemistry and Nuclear Chemistry

146 (RLO-2227-T7-23) OREGON STATE UNIVERSITY NUCLEAR CHEMISTRY PROGRESS REPORT DURING THE PERIOD MARCH 15, 1973–SEPTEMBER 15, 1974. Loveland, W. D. (Oregon State Univ., Corvallis (USA)). Sep 1974. Contract AT(45-1)-2227-T7. 121p. Dep. NTIS $9.25.

The emphasis of the research reported was on the fission process. Six papers dealing with fission and spectroscopic properties of neutron-rich nuclei are title listed separately. In addition, accounts are given of the use of stable activable tracers and naturally occurring trace elements to study atmospheric dispersion models; this work is relevant to air pollution. Instrumentation and methods, personnel, publications, theses, and talks are also included. (RWR)

For title listings of individual papers see: 2018–2020, and 2070–2072.

Hot-Atom Chemistry

147 SZILARD–CHALMERS REACTIONS IN BRIDGED FERROCENE DERIVATIVES. Hillman, M.; Weiss, A. J.; Ebihara, H.; Williams, K. (Brookhaven National Lab., Upton, NY). J. Inorg. Nucl. Chem.; 37: No. 2, 403-406(Feb 1975).

Retentions following (n,γ) reactions in solid state and in solutions in hexane, benzene and dimethylsulfoxide were measured for ferrocene and for four trimethylene bridged derivatives of ferrocene. The retentions decreased with an increase in the number of bridges, differed for isomers containing the same number of bridges, and decreased with increasing polarity of the solvent. A possible intrinsic retention was measured in DMSO, the most polar solvent. All of these results are explained on the basis of ease of the recoiling iron atom to recombine with the organic residue depending on the molecular structure of the residue and on the basis of competition between the solvent and the residue for the iron atom. (auth)

148 CHEMICAL EFFECTS OF THERMAL NEUTRON CAPTURE IN ALKALI AND AMMONIUM PERBROMATES. Hasan, N.; Heitz, C. (Univ., Strasbourg). J. Inorg. Nucl. Chem.; 37: No. 2, 395-398(Feb 1975).

Alkali metal and ammonium perbromates were irradiated in a thermal neutron flux. High-voltage paper electrophoresis gives the following radiobromine distribution: in alkali metal perbromates: Br^- (74%), BrO_3^- (24%), BrO_4^-(1%), in ammonium perbromate: Br^- (87%), BrO_3^- (13%), BrO_4^- (0.2%). On thermal annealing bromide is oxidized to bromate, $^{82}Br^-$ ions being oxidized more rapidly than $^{80m}Br^-$ ions; the perbromate fraction remains unchanged. (auth)

149 EVALUATION OF THE INTEGRATED ENERGY DISTRIBUTION OF $CH_3CF_2{}^{18}F$ RESULTING FROM HOT ATOM CHEMICAL ACTIVATION. Smith, W.S. Jr.; Rodgers, A.S.; Tang, Y. (Department of Chemistry, Texas A&M University, College Station, Texas 77843). J. Chem. Phys. 62: No. 8, 3310-3320 (15 Apr 1975).

A general numerical method has been developed in order to evaluate the integrated distribution of excited molecules prior to unimolecular reaction. The method has been tested on a series of artificially designed distributions and kinetic models in order to determine its effectiveness and limits of applicability. It was then applied to the kinetic data of excited $CH_3CF_2{}^{18}F$. The distribution deduced from the pressure dependence of the decomposition and stabilization products indicates that the activating ^{18}F-for-F primary process results in a very energetic distribution with at least 35% of the activated molecules with energies above 165 kcal $mole^{-1}$. A detailed analysis of the possible reaction channels indicates that both β-HF elimination and C–C bond scission contribute to the over-all mechanism but that the latter is nominally pressure independent even at 30 000 torr. (auth)

Properties of Radioactive Materials

Refer also to abstract 1245.

150 (AD/A-001391) URANIUM–OXYGEN RADIATION STUDIES. Final Report, July 1972–April 1973. Wurster, W. H. (Calspan Corp., Buffalo, N. Y. (USA)). 16 Aug 1974. Contract DNA0001-72-C-0098. 45p. (DNA-3398F). NTIS $3.75.

Progress is reported on a program to measure absolute spectral radiances from uranium-oxygen mixtures. The measurements are made under controlled conditions of temperature and species concentrations, and include infrared data. The experimental plan was to produce an aerosol of uranium in a controlled mixture of oxygen and inert gas such as argon. This aerosol is shock-heated, thereby vaporizing the metal particles, and providing a gaseous mixture of U, O_2 and argon at high equilibrium temperatures. The final data comprise absolutely measured spectral radiances over wavelength regions of interest. The parameters of the experiment are the temperature, relative U/O_2 ratios and wavelength range and resolution. Supporting measurements were conducted during the course of the program. The objectives of these studies included (a) the application of the exploding-wire aerosol shock tube technique to infrared radiance measurements of metallic oxides, (b) studies of the generation and spatial distribution of the uranium aerosols, and (c) relevant species concentration measurements. A supporting theoretical effort involved the use of best available data to provide thermodynamic functions of uranium atoms and oxide molecules. (GRA)

151 (RFP-2258) REDUCTION GASKET FAILURE STUDIES. Tesitor, C. N.; Perry, C. C. (Dow Chemical U. S, A., Golden, Colo. Rocky Flats Div.). 24 Mar 1975. Contract AT(29-1)-1106. 10p. Dep. NTIS $4.00.

This report contains a description of the process and facilities at Rocky Flats for reducing plutonium tetrafluoride to plutonium metal. The report also includes a historical background of the reduction failures problem at the plant, a discussion of factors affecting gasket failures, a discussion of methods used for reducing the number of failures, and methods for eliminating these failures. (auth)

152 ANALITICHESKAYA KHIMIYA RADIYA. (Analytical Chemistry of Radium). Leningrad; Izdatel'stvo Nauka (1973). 190p.

This book is the first monograph on the analytical chemistry of radium. Basic information is presented on the physical-chemical and nuclear properties of radium and its isotopes. All compounds of radium and methods of producing the compounds are characterized. A detailed presentation is given of the radiometric and physical-chemical method of determining radium in various natural and industrial materials. Particular attention is devoted to radiochemical methods of separating and purifying radium from radioactive and alkaline earth elements. Schemes of separating radium from various materials and separating radium from its macrocomponents with the use of the methods of precipitation, extraction and chromatography are presented. (519 references) (tr-auth)

153 PREPARATION OF HEPTAVALENT AMERICIUM. Krot, N. N.; Shilov, V. P.; Nikolaevskii, V. B.; Pikaev, A. K.; Gel'man, A. D.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Chem. (Engl. Transl.); 217: No. 1-3, 525-527 (Jul 1974).

Translated from Dokl. Akad. Nauk SSSR; 217: No. 3, 589-592 (Jul 1974).

Preliminary studies on the oxidation of Am(VI) to the heptavalent form were carried out in 3M NaOH solutions at 0°C, supersaturated with N_2O and γ irradiated to produce the 0^- ion-radical as the oxidizing reagent. The irradiated samples changed from the original light yellow to a greenish shade with an optical density in the 370 to 450 nm range twice that of the original solution. The color faded with time. The passage of ozonized air through NaOH solutions of Am(VI) resulted in the same color change. Stoichiometric oxidations of Pu(VI) and Np(VI) by Am(VI) in 1 to 2M NaOH were observed and confirmed the formation of the heptavalent Am. (JSR)

154 HETEROCYCLIC COMPOUNDS. P. 3. Synthesis of ^{14}C-Labelled 1-(3,4-Dimethoxyphenyl)-5-Ethyl-7,8-Dimethoxy-4-Methyl-5H-2,3-Benzodiazepines. Zolyomi, G.; Banfi, D.; Lang, T.; Koeroesi, J. (Institut fuer Arzneimittelforschung, Budapest (Hungary)). Chem. Ber.; 107: No. 12, 3904-3907(1974). (In German).

The synthesis of [4',8-di-$^{14}CH_3O$]- and [5-$^{14}CH_2CH_3$]-labelled 1-(3,4-dimethoxyphenyl)-5-ethyl-7,8-dimethoxy-4-methyl-5H-2,3-benzodiazepine is described, starting from the known basic materials. (auth)

155 (α,n) REACTIONS IN URANIUM SOLUTIONS. Raut, M. K.; Attrep, M. (East Texas State Univ., Commerce). J. Inorg. Nucl. Chem.; 37: No. 1, 274-276(Jan 1975).

In this investigation attempts are made to express quantitatively the contribution of (α,n) reactions on nuclei of light elements, such as beryllium, to the ratio of thermal neutron-induced fission of ^{235}U to the spontaneous fission of ^{238}U in natural uranium in an aqueous medium. Since the previous investigation (Attrep et al., J. Inorg. Nucl. Chem.; 34: 435 (1972)) of (α,n) reactions in uranium assemblies has been of the uranium in the solid form, the purpose of this investigation is to observe the alterations of the magnitude of the nuclear process of induced fission as contributed to by light elements in an aqueous medium. This, in part, might represent some conditions of uranium mineral deposits in nature and the effect of the change of chemical composition on the nuclear geochemical character of the system. The results are presented and discussed. (UK)

156 DECONTAMINATION OF SURFACES. Methods For Testing the Decontaminability. Draft. pp DIN 25415, B1.1 of German Norms. Berlin, F. R. Germany; Beuth (Sep 1974). (In German).

Objective criteria are given for testing the decontaminability of surfaces. The proposals do not discuss or describe a general decontamination method, nor any mechanical measures (such as stirring or rubbing, etc.). (GE)

157 INORGANIC CHEMISTRY OF THE TRANSITION ELEMENTS. Volume 3. A Review of the Literature Published Between October 1972 and September 1973. London; Chemical Society (1974). 538p.

This review is divided into the following sections: Chapter 1. The early transition metals Ti, Zr and Hf, V, Nb and Ta, Cr, Mo and W, Tc and Re. Chapter 2. Elements of the first transitional period Mn, Fe, Co, Ni, Cu. Chapter 3. The noble metals Ru, Os, Rh, Ir, Pd, Pt, Ag, Au. Chapter 4. Scandium, yttrium,

the lanthanides, and the actinides, uranyl and related compounds. (UK)

158 THERMODYNAMIC DATA CONCERNING THE DIOXOURANIUM(VI) ION AND ITS COMPOUNDS AND REACTIONS. Marcus, Y. (Hebrew Univ., Jerusalem). J. Inorg. Nucl. Chem.; 37: No. 2, 493-501(Feb 1975).

An evaluation of the lattice enthalpy of a uranyl salt was made for the first time, yielding for UO_2F_2 the value $\Delta H_{lat\,298}$/kJ mole^{-1} = 2330. This permitted the estimation of numerous other important enthalpy values, such as the heats of formation $\Delta H_{f\,298}(UO_2^{2+}(g))$kJ mole^{-1} = 1210, and $\Delta H_{f\,298}(UO_2(NO_3)_2TBP)_2(l))$/kJ mole^{-1} = −4425, the lattice energy $\Delta H_{lat\,298}(UO_2(NO_3)_2(c))$/kJ mole^{-1} = 1936, the hydration energy $\Delta H_h^0(UO_2^{2+})$/kJ mole^{-1} = −1361, and the bond energy between the uranyl cation and the phosphoryl oxygen of a TBP molecule in the isolated adduct molecule of 200 kJ mole^{-1}. The entropy change for the formation of the adduct has also been evaluated. (auth)

159 HYDROXOCHLOROURANATE(IV) AND ITS CYCLOHEXANOL CLATHRATE. Bhattacharyya, R. G. (Jadavpur Univ., Calcutta). J. Inorg. Nucl. Chem.; 37: No. 2, 579-581 (Feb 1975).

Reference is made to the preparation [Majumdar et al., J. Inorg. Nucl. Chem., 26, 386(1964)] of $UCl_4 2Ph_3P\ C_6H_{11}OH$, later identified as a clathrate of $[Ph_3PH]_2\ [U(OH)_2Cl_4]$ with cyclohexanol. The present note reports that if the cyclohexanol solvent is completely saturated with HCl gas, and the previous experiment repeated, a new clathrate compound $(Ph_3PH)_2\ [U(OH)Cl_5]\ C_6H_{11}OH$ is obtained, which on crystallization from acetonitride affords a new complex $(Ph_3PH)_2\ U(OH)Cl_5$. (auth)

160 ELECTRON SPIN RESONANCE OF URANIUM(IV) CHELATES WITH CUPFERRON AND NEOCUPFERRON. Yoshimura, T.; Miyake, C.; Imoto, S. (Osaka Univ., Suita, Japan). J. Inorg. Nucl. Chem.; 37: No. 3, 739-742(Mar 1975).

ESR spectra were observed on tetrakis(cupferronato)uranium (IV) and tetrakis(neocupferronato)uranium(IV) at room temperature and 77°K with g-value of 4.27 and 4.50 respectively. In the solution of degassed tetrahydrofuran, the same signal was observed only at 77°K. Since these signals did not appear in the corresponding diamagnetic complexes with Th(IV), Ce(IV), Hf(IV), Zr(IV), and Ti(IV), the spectra were discussed from the point of the crystal field effect with the symmetry of D_{4d} on $^3H_4$ term of U(IV) with $(5f)^2$ electronic configuration. On the other hand, ESR spectra having g-values of 2.003 ~ 2.005 were also observed irrespectively to the kind of the central metal ion. As one of the possible causes of these signals, an unpaired electron produced by an N-N bond fission in the ligand after the formation of the complex seems to be considered. (auth)

161 REACTION OF URANIUM TETRAFLUORIDE WITH URANIUM MONONITRIDE. Tagawa, H. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 37: No. 3, 731-733(Mar 1975).

The reaction of UF_4 with UN at 950°C yields UF_3 or UNF depending on the mixing ratio; the product is UF_3 for the UF_4 : UN ratio of 3 : 1, and UNF for 1 : 3. The reaction is generally expressed as $x\ UF_4(S) + y\ UN(S) \rightarrow [(3x-y)/2]\ UF_3(S) + [(3y-x)/2]\ UNF(S) + [(x-y)/4]\ N_2(g)$. The free energy change for the formation of UF_3 is discussed on the basis of the experimental results. (auth)

162 SYMMETRY ASSIGNMENTS OF THE OPTICAL SPECTRUM OF $CsUO_2(NO_3)_3$. Leung, A. F. (Chinese Univ. of Hong Kong, Shatin). J. Phys. Chem. Solids; 36: No. 4, 346-348(Apr 1975).

The great similarity in the electronic spectra of uranyl salts suggests that surrounding ligands have relatively small influence on the uranyl ion. The interactions within the uranyl ion determine the major structure of the electronic spectrum of any uranyl salt. The first excited configuration of the uranyl ion consists of a 5f electron and a hole in the chemical bondings. Then, the coupling between the 5f electron and the hole in the chemical bondings can give some information about the energy levels of the first excited configuration of uranyl salts. A sample calculation that applies specifically to a $CsUO_2(NO_3)_3$ single crystal is given. Only the lower energy levels of the excited configuration are calculated. (auth)

163 URANIUM(IV) POLY(PYRAZOL-1-YL)BORATE COMPLEXES. Bagnall, K. W.; Edwards, J.; du Preez, J. G. H.; Warren, R. F. (Univ. of Manchester, Eng.). J. Chem. Soc., Dalton Trans.; No. 2, 140-143(1975).

The uranium(IV) tetrakis [(pyrazol-1-yl)borates], $U[H_nB(pz)_{4-n}]_4$ (pz = $C_3H_3N_2$ and n = 1 or 2), and $[UCl_2\{HB(pz)_3\}_2]$ were prepared. Some evidence for the formation of $K[UCl_3\{H_2B(pz)_2\}_3]$, thf (thf = tetrahydrofuran) was also obtained. The H nmr, ir, and electronic spectra of these complexes are discussed. (auth)

164 PREPARATION OF ASTATINE LABELLED PROTEINS. Aalj, C. (Central Lab. of the Netherlands Red Cross Blood Transfusion Service, Amsterdam); Tschroots, W. R. J. M.; Feltkamp, T. W. W.; Lindner, L. Int. J. Appl. Radiat. Isotop.; 26: No. 1, 25-30(Jan 1975).

Methods are described for the labelling of protein antigens with astatine, a halogen of which no stable isotopes exist. The radionuclide ^{211}At ($t_{\frac{1}{2}}$ = 7.2 hr), which decays by electron capture and by emission of α particles, was used. Electro-oxidation of ^{211}At showed that up to 30% of its radioactivity was bound to the proteins. It was shown that with H_2O_2 as oxidant even higher rates of incorporation were obtained. Up to 60% of the ^{211}At could be coupled to microgram amounts of protein. Specific radioactivities of 1 μCi per μg protein were obtained. Using immunoelectrophoretic and autoradiographic methods, it was demonstrated that neither the labelling process nor the radiation emitted by the ^{211}At caused any appreciable denaturation of the protein antigens. (auth)

165 REPURIFICATION OF A HIGHLY DAMAGED ^{125}I-HGH PREPARATION. Keret, R.; Klonitsky, S.; Laron, Z. (Beilinson Hospital, Israel). Int. J. Appl. Radiat. Isotop.; 26: No. 1, 32-33(Jan 1975).

A method is described whereby ^{125}I-HGH which had become highly damaged and unusable for radioimmunoassay after having been kept 3 weeks in an unfrozen condition was repurified. The highly damaged hormone was eluted with 0.07 M barbital buffer pH 8.6 containing 0.1% merthiolate and 0.3% horse serum through a Sephadex G-75 column (80 × 1.2 cm) with a flow rate of 1 ml/4 min. The elution pattern obtained showed three peaks, of which one represented undamaged hormone and it was demonstrated that this material maintained the same immunoreactivity as that in fresh hormone. (UK)

166 PREPARATION METHODS FOR URANIUM–PLUTONIUM NONOXIDE FUELS. Richter, K. Trans. Amer. Nucl. Soc.; 20: 595-596(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

167 IMPACT OF URANATE CALCINATION REGIME AND URANIUM DIOXIDE SINTERING SCHEDULES ON THE PREPARATION OF PELLETS OF CONTROLLED DENSITIES. Farah, M. Y.; El-Fekey, S. A.; Hammad, F. H.; Bishay, A. F. Trans. Amer. Nucl. Soc.; 20: 607-611(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

168 STUDY OF PENTAVALENT PROTACTINIUM COMPLEXES IN SULFURIC, PHOSPHORIC, AND SULFOPHOSPHORIC MEDIA. Le Cloarec, M. F.; Miranda, C. F.; Franck, J. C. (Fondation Curie-Institut du Radium, 94–Arcueil (France). Lab. d'Arcueil); Guillaumont, R. (Paris-11 Univ., 91–Orsay (France). Div. de Radiochimie). Radiochim. Acta; 20: No. 1/2, 1-6(1973). (In French).

In aqueous sulfate-, phosphate-, and sulfate/phosphate-containing solutions of ionic strength μ = 1, defined by $0.1 <= [H^+] <= 1$ M, $[H_3PO_4] <= 0.5$ M and $[HSO_4] <= 0.5$ M, pentavalent protactinium forms a series of hydroxide complexes, which contain 1 to 3 phosphate groups per Pa atom in phospate-containing medium, 1 to 2 sulfate groups in sulfate-containing medium, and up to 3 phosphate groups per sulfate group in mixed solutions. The charge is between 1– and 2+. The equilibrium constants were calculated from which the formation of these units from the $PaOOH^{2+}$ cation becomes evident. These results were obtained by studying the solvent extraction of $^{233}Pa(V)$ in chelate form in thenoyl trifluoracetone benzene solutions from the investigated media, and the electrophoretic behavior on glass fiber of the complexes formed in the mixed medium. (GE)

169 PLUTONIUM, A FISSIONABLE MATERIAL BETWEEN FRIGHT AND HOPE. Keller, C. Bild Wiss.; 11: No. 12, 90-97 (Dec 1974). (In German).

With figs.

A survey is presented on the element plutonium, its isotopes and its main compounds. In particular a treatment is given on the following subjects: the discovery of Pu, production of the most important isotopes and its production on a technical scale, in which connection the Manhattan Project as well as the thermal recycling of the power reactor produced plutonium and the utilization as nuclear fuel in fast breeder reactors are briefly described. Use of Pu-238 in isotope batteries and cardiac pacemakers, and, finally, the interest of research in the element plutonium on grounds of its particular physical and chemical properties are considered. (GE)

170 SOLVOLYTIC EQUILIBRIA IN METHANOL AND ACETONITRILE OF SOME DIOXOURANIUM[VI] COMPLEXES

WITH HEXAMETHYL PHOSPHORAMIDE. Bhattacharyya, R. G.; Bera, D. C. (Jadavpur Univ., Calcutta). Indian J. Chem.; 12: No. 9, 977-981(Sep 1974).

Neutral complexes of the type UO_2X_2Ln (L = hexamethyl phosphoramide and X = Cl, Br, NO_3 or NCS when n = 2; and X = NCS when n = 3) produce conducting solutions in methanol and acetonitrile and in sufficiently dilute solution behave as 2 : 1 and 1 : 1 electrolytes respectively. Different types of solvation equilibria in these two solvents are considered. The respective equilibrium constants, calculated using Fuoss and Kraus method, are found to lie in the range of 10^{-3}-10^{-4} in methanol and 10^{-5}-10^{-6} in acetonitrile. The equilibrium constants of the acid solvolysis reaction in methanol (K_{CH_3OH}) are, in general, considerably higher than those in acetonitrile (K_{CH_3CN}). Anion solvation through solvent-assisted dissociation in the case of methanol and the absence of this phenomenon in acetonitrile might be a probable reason for this behavior. Such anion solvation is also responsible for the lower Λ_0 values of the complexes in methanol than those in acetonitrile. (auth)

171 STABILITIES OF URANYL COMPLEXES OF METHYL 3-MERCAPTOPROPIONATE. Saxena, R. S.; Bhatia, S. K. (Malaviya Regional Engineering Coll., Jaipur, India). Indian J. Chem.; 12: No. 9, 1004-1005(Sep 1974).

Complex formation between uranyl ion and methyl 3-mercaptopropionate ($CH_3OOCCH_2CH_2SH$) has been studied in 25% ethanol, employing potentiometric and conductometric techniques. 1 : 1 and 1 : 2 complexes are formed in the pH range 3.80-5.50 whose log K_{stab} values, determined by Calvin-Melchior's extension of Bjerrum's method and refined by correction term method, are 4.96, 4.55 at 25°C; 4.89, 4.52 at 35°C and 4.84, 4.44 at 45°C respectively. ΔG, ΔH and ΔS accompanying complexation at 35°C are -13.26 kcal/mole, -10.40 kcal/mole and 8.896 cal/deg/mole respectively. (auth)

172 LABELLING OF AMINO-ACID SIDE-CHAINS WITH ^{13}C-LABELLED ELECTROPHILES; POTENTIAL APPLICATION TO THE PROBING OF ACTIVE SITES OF ENZYMES. Climie, I. J. G.; Evans, D. A.; Akhtar, M. (Southern Methodist Univ., Dallas). J. Chem. Soc., Chem. Commun.; No. 5, 160-161(5 Mar 1975).

Side-chain groups in functional amino acids appropriately protected at both terminii have been treated with electrophilic inhibitors (e.g. acrylonitrile), ^{13}C n.m.r. spectroscopy allowing unambiguous elucidation of the reacting side-chain functionality; an extension of this technique using ^{13}C-enriched inhibitors to the study of enzyme active-site environment is discussed. (auth)

173 KINETICS AND MECHANISMS OF THE REACTIONS OF URANIUM(III) WITH VANADIUM(III), VANADIUM(IV) AND IRON (III) IN PERCHLORATE MEDIA. Ekstrom, A.; McLaren, A. B.; Smythe, L. E. (Australian Atomic Energy Commission, Sydney). Inorg. Chem.; 14: No. 5, 1035-1038(May 1975).

The kinetics and mechanisms of the reactions of U(III) with Fe(III), V(III), and V(IV) have been studied. The reactions of Fe(III) and V(IV) were found to be independent of acid concentration, while the rate of reaction of U(III) and V(III) increased with decreasing acid concentration. The ionic strength dependency of the three reactions was examined and the reaction parameters were measured. The results obtained are compared with those reported for other related systems and reaction mechanisms consistent with the observed results are discussed. (auth)

174 SYNTHESIS, CHARACTERIZATION, AND STRUCTURE OF URANIUM OXIDE TETRAFLUORIDE. Paine, R. T.; Ryan, R. R.; Asprey, L. B. (Los Alamos Scientific Lab., NM). Inorg. Chem.; 14: No. 5, 1113-1117(May 1975).

The synthesis of uranium oxide tetrafluoride from the combination of uranium hexafluoride and quartz wool (SiO_2) in anhydrous hydrogen fluoride solution is reported. The slow reaction $4HF + SiO_2$ yields $SiF_4 + 2H_2O$ provides a stoichiometric, one-step, controlled, partial hydrolysis of UF_6. The characterization of UOF_4 including electronic and vibrational spectra of the solid is presented. The crystal structure as determined from three-dimensional single-crystal x-ray data collected by counter methods is described. A full-matrix least-squares refinement using 300 observed reflections resulted in a final R equals 4.2 percent. The structure refines in the trigonal space group R3m. The hexagonal cell constants are a equals 13.22 (1) A and c equals 5.72 (1) A with V equals 865.7 cm^3, dc equals 5.70 g/cm^3, and Z equals 9. The idealized coordination sphere of UOF_4 consists of a pentagonal bipyramid of light atoms surrounding the central uranium. An oxygen atom and fluorine atom occupy indistinguishable axial positions with the U-O and U-F distances in the range 1.77-1.79 (3) A. The equatorial belt contains one unique unbridged fluorine (U-F/sub eq/ equals 1.98 (3) A) and four bridged fluorines (U-F/sub br/ equals 2.25-2.29 (3) A). The observed chemistry and structure are compared and discussed in relation to transition metal oxide tetrafluorides and previously reported uranium oxide fluorides. (auth)

175 ELECTRON EXCHANGE REACTION BETWEEN URANIUM(VI) AND TIN(II) IN VARIOUS N-METHYLACETAMIDE-WATER MIXED SOLVENTS. Mayhew, R. T.; Amis, E. S. (Univ. of Arkansas, Fayetteville). J. Phys. Chem.; 79: No. 9, 862-865 (24 Apr 1975).

The reduction of U(VI) with Sn(II) was studied in 20, 40, 65, and 80 wt percent N-methylacetamide-water solutions. The reaction rates were calculated using the second-order rate equation in 1, 2, 4, and 6 M HCl solutions in all the mixed solvents at 30, 40, and 50°C. The change in rate constant with both change in solvent composition and HCl concentration was considered as possibly arising from the composition and charge (including sign) of the reacting complex ions, the macroscopic dielectric constants of the solvents, and the ionic strengths of the solutions. Certain limitations of the NMA-H_2O solvent systems for this reaction and these acidities were pointed out. (auth)

176 RADIUM REMOVAL FROM DRINKING WATER. Moore, W. S. (Naval Oceanographic Office, Chesapeake Beach, MD) Cook, L. M. Nature (London); 253: No. 5489, 262-263(24 Jan 1975).

It is stated that Ra can be absorbed from natural waters onto acrylic fibres impregnated with oxides of Mn. This extraction technique has been developed for oceanographic studies, but is also effective for removing Ra from drinking water. The apparatus and technique adopted for this application are described. Some tests of the method on highly contaminated well water showed essentially complete removal of the Ra, and the cost is low. It is emphasized that the method is still at the testing stage. (UK)

177 ULTRASONIC PRODUCTION OF ^{131}I-HSA PARTICLES SUITABLE FOR LIVER SCINTIGRAPHY. Kutas, V.; Kocsar, L.; Holland, J. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszawfugyi Kutato Intezet, Budapest). Int. J. Appl. Radiat. Isotop.; 26: No. 1, 31-32(Jan 1975).

A method is described of producing ^{131}I-HSA-macroaggregates for lung and liver scanning using ultrasonic waves. Twenty batches have so far been produced by the method given. Characteristics of ^{131}I-HSA microaggregate on the day of production are given as: specific activity 1.612 mCi/mg; radioactive concentration 0.806 mCi/ml; protein content 0.5 mg/ml; pH 7.0; diameter of the particles <5 μm; free iodine content about 2 to 3% containing 0.9% benzylalcohol bacteriostat. Biological studies were performed in order to gain information about the accumulation of the microaggregate in the liver, lungs, spleen, and other organs and these are summarized. (UK)

178 U(V) DISMUTATION AND U(IV) PRODUCTION RATES DURING THE PHOTOREDUCTION OF U(VI) BY ETHANOL IN PERCHLORIC ACID MEDIUM. Feve, M. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). Compt. Rend., Ser. C; 279: No. 17, 721-724(21 Oct 1974). (In French).

The photoreduction of uranyl perchlorate by ethanol in perchloric acid medium was studied by polarography. It was shown that U(V) was produced by photochemical reaction and U(IV) by U(V) dismutation. (FR)

179 TECHNICAL SHEET OF THE REVIEW: IONIZING RADIATIONS. I. Decontamination. Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 181-192(Oct 1974). (In French).

A start has been made on the publication of technical sheets to bring together the practical information, frequently the research work, that are only accessible with difficulty. The information is presented, by item, with tables as complete as possible. This paper concerns decontamination. The following ones will cover the practical techniques for detecting and determining ionizing radiations (different kinds of appliances, references, suppliers) and nonionizing radiations (standards, protection). (FR)

Radioactive Waste Treatment

Refer also to abstracts 214, 1565, 2215, and 2253.

180 (COM-74-11529) ACTIVATED CARBON. A Bibliography with Abstracts. Report for 1964-September 1974. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Sep 1974. 206p. (NTIS/WIN-74/075). NTIS $20.00.

Supersedes report No. NTIS-PK-157, COM-73-11383.

This bibliography contains 190 selected abstracts of research reports retrieved using the NTIS on-line search system-NTISEARCH. The report is divided into two parts. The first cites research dealing with activated carbon treatment of waste

waters. This concerns both laboratory as well as engineering studies. The second part covers all other reports involved with the use or properties of activated carbon or activated charcoal. This includes studies on air pollution control, gas and water analysis, and the adsorption of chemicals and radioactive isotopes. (GRA)

181 (ENG-9-DC-74-05) DESIGN CRITERIA (REVISED) FOR TRANSURANIC CONTAMINATED SOLID WASTE TREATMENT DEVELOPMENT FACILITY. Jordan, H. S.; Herceg, J. E.; Valentine, A. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 23 Apr 1974. Contract W-7405-ENG-36. 29p. Dep. NTIS $4.50.

Design criteria of the waste treatment facility are presented in the following sections: purpose and physical description; applicable codes, standards, and AEC manual chapters; civil; architectural; structural; mechanical; electrical; fire protection; quality assurance; security; and criteria drawings. (JGB)

182 (RFP-2340) PROTOTYPE HYDRIDING APPARATUS (APPLICATION FOR PLUTONIUM RECOVERY). DeGrazio, R. P. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 17 Mar 1975. Contract AT(29-1)-1106. 12p. Dep. NTIS $4.00.

The major components and the operation of an experimental hydriding prototype apparatus are described. The apparatus was designed to recover plutonium from metallic substrates. The plutonium recovery operation is based on the plutonium–hydrogen reaction: $Pu^0 + H_2$ yields PuH_2 DELTA H equals -37.4 +- 1.2 kcal mol^{-1} Pu. (auth)

183 METHOD OF RADIOACTIVE WASTE PROCESSING. Durcak, H. (to Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (F. R. Germany)). German(FRG) Patent 1,767,999/A/. 28 Feb 1974. 11p. (In German).

A processing method for radioactive liquid wastes, as occurring in nuclear power plants or in th regeneration of ion exchangers is reported. The radioactive nuclides, in particular iodine-131 and -133, barium-140, strontium-91, and heavy metal nuclides, are thus precipitated out after adding carrier solutions and are flocculated together with iron hydroxide. The patent claims deal with type and amount of the carrier addition, the pH-conditions, and the order in which the precipitations occur. (GE)

184 EMBEDDING WASTES FROM A LIGHT-WATER REACTOR IN THERMOSETTING RESINS. Cuaz, D.; Limongi, A.; Traxler, A. Trans. Amer. Nucl. Soc.; 20: 654-656(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

185 BITUMINIZATION OF RADIOACTIVE WASTES: SAFETY PROBLEMS AND APPLICATION FIELDS. Lefillatre, G.; Leconnetable, J. Trans. Amer. Nucl. Soc.; 20: 657-658(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

186 MEDIUM LEVEL WASTE BITUMINIZATION PLANT AND ENGINEERED STORAGE FACILITY AT EUROCHEMIC. Detilleux; Eschrich, H.; Balseyro; Storrer, J.; De Beukelaer, R.; Van Averbeke, J.; Shank, E. M.; Joseph; Smeyers. Trans. Amer. Nucl. Soc.; 20: 658-661(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

187 BITUMINIZATION OF LIQUID AND SLURRY RADIOACTIVE WASTE IN A MOBILE UNIT. Shank, E. M. Trans. Amer. Nucl. Soc.; 20: 661-662(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

188 TREATMENT AND DISPOSAL OF TRIBUTYL PHOSPHATE-KEROSENE WASTE BY THE EUROWATT PROCESS. Salomon, L.; Eschrich, H.; Humblet, L. Trans. Amer. Nucl. Soc.; 20: 663-666(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

189 STUDIES ON THE FIXATION OF FISSION PRODUCTS IN CERAMIC MATERIALS. De, K.; Luchscheiter, B.; Lutze, W.; Malow, G.; Schiewer, E. Trans. Amer. Nucl. Soc.; 20: 666-669 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

190 NEW METHOD FOR THE FIXATION OF HIGH LEVEL RADIOACTIVE WASTES. Heimerl, W. Trans. Amer. Nucl. Soc.; 20: 669-671(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

191 NEW DEVELOPMENTS ON THE SOLIDIFICATION OF HIGH LEVEL RADIOACTIVE WASTES AT EUROCHEMIC. van Geel, J.; Eschrich, H. Trans. Amer. Nucl. Soc.; 20: 671-680(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

192 CONTINUOUS VITRIFICATION OF CONCENTRATED SOLUTIONS OF FISSION PRODUCTS. Jouan, A.; Sombret, C. Trans. Amer. Nucl. Soc.; 20: 680-682(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

193 FIXATION OF RADIOACTIVE WASTE FOR POSTERITY. Grover, J. R.; Johnson, K. D. B.; Morris, J. B. Trans. Amer. Nucl. Soc.; 20: 682-684(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

194 TRANSPORT AND SOLIDIFICATION OF LIQUID WASTES FROM LIGHT-WATER REACTORS. Christ, R.; Herzog, J.; Witte, H. Trans. Amer. Nucl. Soc.; 20: 684-686(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

195 A METHOD AND PRODUCTS FOR PURIFYING AQUEOUS SOLUTION AND SEWAGE. Pruna, M. French Patent 2,201,257/A/. 26 Sep 1972. 4p. (In French).

The method consists of purification through a physical and chemical treatment comprising the steps of extracting the impurities contained in aqueous solutions or in sewage by means of a preferential solution adsorbing or absorbing the impurities and separating the purified portions from the adsorbed or absorbed impurities. That process is carried out through conventional mixing, adsorbing or absorbing and separating operation. As a particular application can be mentioned the decontamination of radioactive waters. (FR)

Radioisotope Production

196 ISOLATION OF ^{82}Sr FROM 200 TO 600 MeV PROTON-IRRADIATED Mo TARGETS FOR BIOMEDICAL APPLICATIONS. Grant, P. M. (Los Alamos Scientific Lab., NM); O'Brien, H. A. Jr.; Kahn, M. J. Inorg. Nucl. Chem.; 37: No. 2, 413-417(Feb 1975).

^{82}Sr is of interest in nuclear medicine as the generator of its short-lived daughter, ^{82}Rb. Experimentation has begun at the Clinton P. Anderson Meson Physics Facility, and spallation reactions have been induced in Mo targets with 200- to 600-MeV protons to produce microcurie amounts of a variety of radionuclides. A six-step radiochemical procedure, incorporating precipitation, solvent extraction, and ion exchange techniques, has been developed for the separation and purification of Sr radioactivities from other spallation products and the bulk target material. γ-Ray spectrometry was used for isotope characterization, and chemical yields of ten different spallation-induced radioelements were determined for this analytical scheme. Radiostrontium can be quantatively recovered in a sufficiently decontaminated state for use in biomedical generator development, and this procedure is being scaled up to a hot cell operation for actual production irradiations. (auth)

197 PRODUCTION OF ^{28}Mg BY TRITON AND α-PARTICLE INDUCED REACTIONS. Nozaki, T.; Furukawa, M.; Kume, S.; Seki, R. (Inst. of Physical and Chemical Research, Wako, Saitama, Japan). Int. J. Appl. Radiat. Isotop.; 26: No. 1, 17-20 (Jan 1975).

The yields of ^{28}Mg for the reactions of triton on magnesium, aluminum, and silicon and for those of α-particles on magnesium and aluminum were measured up to a triton energy of 24 MeV and an α energy of 42 MeV. These reactions are compared with a view to the practical production of ^{28}Mg for tracer use. A convenient process for the carrier-free separation of ^{28}Mg from an aluminum target is described. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 2293.

198 (ORNL-TM-4698) ENGINEERING DEVELOPMENT STUDIES FOR MOLTEN-SALT BREEDER REACTOR PROCESSING NO. 18. Hightower, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 52p. Dep. NTIS $5.45.

A water–mercury system was used to study the effect of geometric variations on mass transfer rates in rectangular contractors similar to those proposed for the molten-salt breeder reactor (MSBR) fuel reprocessing scheme. Since mass transfer rates were

not accurately predicted by the Lewis correlation, other correlations were investigated. A correlation which was found to fit the experimental results is given. Mass transfer rates are being measured in a fluoride salt–bismuth contactor. Experimental results indicate that the mass transfer rates in the salt–bismuth system fall between the Lewis correlation and the modified correlation given above. Autoresistance heating tests were continued in the fluorinator mock-up using $LiF–BeF_2–ThF_4$ (72-16-12 mole percent) salt. The equipment was returned to operating condition, and five experiments were run. Although correct steady-state operation was not achieved, the results were encouraging. A two-dimensional electrical analog was constructed to study current flow through the electrode sidearm and other critical areas of the test vessel. These studies indicate that no regions of abnormally high current density existed in the first nine runs with the present autoresistance heating equipment. Localized heating had previously been the suspected cause for the failure to achieve proper operation of this equipment. (auth)

199 ADAPTATION OF THE PUREX PROCESS TO THE REPROCESSING OF FAST REACTOR FUELS. Boudry, J. C. (Centre de La Hague, Cherbourg, France); Miquel, P. pp 1551-1567 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The enhanced fission-product content of highly irradiated fuels tends to reduce the selectivity of TBP with respect to the extraction of plutonium nitrate and uranyl nitrate. Some new improvements are required in such areas as feed clarification, the design of liquid-liquid contactors, and process chemistry. In a process utilizing existing plant, small amounts of hydrogen fluoride (HF) were added in the first extraction feed to eliminate the very bad effects due to the zirconium. This process has been in use since 1968 for the reprocessing of metallic fuels in the Marcoule plant. It has been successfully adapted for the reprocessing in the AT.1 pilot plant at La Hague of fast reactor fuels irradiated up to 80,000 MWd/t. (auth)

200 SCALE-UP OF AIR PULSED MIXER-SETTLERS FOR THE REPROCESSING OF NUCLEAR FUELS. Johannisbauer, W.; Kaiser, G. (Kernforschungsanlage, Juelich, Ger.). pp 243-261 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A bench-scale, air-pulsed mixer-settler was developed from a small-scale stirred model. Experiments with it demonstrated that it could in principle be used in the JUPITER pilot plant, which is to be built for the reprocessing of thorium-containing nuclear fuels. For a more exact determination of the dimensions necessary for the JUPITER model, a study was made of the mass transfer in the mixing chamber, the phase separation characteristics in the settling chamber and the transport of fluids through a mixer-settler stage using two additional mixer-settlers of increasing size. The data obtained were used to establish general criteria for still larger scale-ups. (auth)

201 SOME MODIFICATIONS OF A PUREX PROCESS FOR THE RECOVERY OF NEPTUNIUM. Tsuboya, T.; Tanaka, T.; Nemeto, S.; Hoshino, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). pp 1985-1996 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A method for discharging Np into the waste streams of 2D bank (U purification step) or 2A bank (Pu purification step) of the Purex process designed for LWR fuels reprocessing was examined in counter-current solvent extraction experiments using a laboratory scale mixer-settler. The oxidation of Np(V) to Np(VI) by HNO_2 and higher scrub acid concentrations in either the M.A. bank or the 1A bank were necessary to discharge more Np into the product streams of each bank. These additive conditions were decided by the use of a computer code, NEPTUN, for simulating the stage concentration profiles of Np. The Np behavior in the banks was also studied by the quantitative analysis of the oxidation-reduction reactions of Np in the banks. (auth)

202 REVIEW OF METALLIC FAST REACTOR FUEL REPROCESSING AT DOUNREAY. Mills, A. L.; Lillyman, E. (United Kingdom Atomic Energy Authority, Dounreay, Eng.). pp 1499-1517 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Solutions of 6, 20, 25, and 30% tri-n-butyl phosphate in odorless kerosene were all used as first cycle solvents in the Purex type reprocessing of Dounreay Fast Reactor fuels. The superior performance of the 6% TBP system is attributed to the physical properties of the solvent and to the formation of a hitherto unreported solvate $[UO_2(NO_3)_2]_a[HNO_3]_b[TBP]_c$. (auth)

203 REVIEW OF THE SUITABILITY OF SOLVENT EXTRACTION FOR THE REPROCESSING OF FAST REACTOR FUELS. Warner, B. F.; Naylor, A.; Duncan, A.; Wilson, P. D. (British Nuclear Fuels Ltd., Windscale, Eng.). pp 1481-1497 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The application of solvent extraction to the reprocessing of fast breeder reactor fuel was previously questioned on the grounds of radiation damage to the solvent. However, calculations suggest that in pulsed columns or centrifugal contactors, residence times and exposure to radiation would be low enough to permit satisfactory operation. The validity of this prediction has been largely confirmed by a small-scale counter-current trial in which a fuel solution containing over 5000 Ci of fission products per liter was successfully processed through a first cycle incorporating the separation of plutonium from uranium. (auth)

204 FISSION PRODUCT BEHAVIOR IN A TWO-SOLVENT EXTRACTION SYSTEM FOR ENRICHED URANIUM. Lewis, L. C.; Rohde, K. L. (Allied Chemical Corp., Idaho Falls, ID). pp 1534-1550 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

At the Idaho Chemical Processing Plant operated by Allied Chemical Corporation for the USAEC, the first solvent extraction cycle for uranium recovery uses tributyl phosphate in hydrocarbon diluent; the second and third cycles use methyl isobutyl ketone as the solvent. Data for decontamination of uranium from fission products are presented for aluminium alloy fuels, zirconium fuels, zirconium-aluminium alloy fuels blended, and stainless steel clad fast reactor fuels to indicate the performance of the two-solvent system. Decontamination factors will be compared to those for the Purex, Redox, and Hexone-25 processes. There are no process problems associated with the presence of two solvent systems in the same plant. (auth)

205 UTILIZATION OF HYDROXYLAMINE NITRATE FOR THE FINAL CONCENTRATION AND PURIFICATION OF PLUTONIUM IN THE IRRADIATED FUEL REPROCESSING FACTORY AT LA HAGUE. Patigny, P. (Centre de La Hague, Cherbourg, France); Regnier, J.; Taillard, D.; Miquel, P. pp 2019-2033 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The use of hydroxylamine nitrate has been examined as a means of back-extracting plutonium in a third cycle of purification and concentration using 30% TBP/dodecane. The tests have indicated the parameters which are important in governing the back-extraction; acidity, concentration of plutonium, presence of hydrazine, and temperature. This method has been used for several months on an industrial scale, and has permitted concentration factors of 8 to 10 and the production of very pure plutonium oxide. (auth)

206 METAL RETENTION BY HYDROXAMIC ACIDS IN IRRADIATED TBP SOLUTIONS. Healy, T. V.; Pilbeam, A. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 459-468 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

An attempt was made to show the effects of hydroxamic acids on metal retention by tributyl phosphate/kerosene in nuclear fuel reprocessing under both simulated and actual conditions. (auth)

207 PERFORMANCE OF EXTRACTION EQUIPMENT IN THE WAK-PILOT PLANT. Huppert, K. L.; Issel, W.; Knoch, W. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Leopoldshafen, Ger.). pp 2063-2074 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Mixer-settlers are used in the German pilot plant for the reprocessing of nuclear fuels. Accumulation of solids presents serious problems and requires design changes. The behavior of precipitates in pulse columns and centrifugal contactors was tested. Conclusions are drawn with respect to scale-up and the processing of high-burnup fuels. (auth)

208 EXPERIENCES OF HIGHLY ENRICHED URANIUM REPROCESSING IN THE EUREX PILOT PLANT. Cao, S. (CNEN,

Saluggia, Italy); Hall, A.; Dworschak, H. pp 1453-1480 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The results of the reprocessing campaign of irradiated MTR fuel elements with long-chain tertiary amines as extractant in the Eurex pilot plant in Italy are discussed. Besides the U recovery and the FP decontamination performances particular emphasis is given to the U/Pu separation, which was achieved in two steps, first by addition of sulfuric acid as Pu(IV) complexant to the 2nd cycle extraction and scrubbing sections and secondly by the treatment of the concentrated U final product with an organic diluent soluble hydroxamic acid (HX). Np was mainly separated from U by the HX process. Finally a brief description is given of the results obtained with a 5% TBP–kerosene flowsheet, still for highly enriched U recovery from MTR elements, at Eurex. (auth)

209 WHY REPROCESS NUCLEAR FUELS. Buckham, J. A. (Allied Chemical Corp., Idaho Falls, ID). Chem. Eng. Progr.; 71: No 3, 21-25(Mar 1975).

Seven basic reasons are given for the desirability of reprocessing spent fuels. They are: better waste management; possibility for improved waste management; recycle of Pu; recovery of unused U; permits development of breeder reactors; permits use of thorium ore; and, makes fission product utilization possible. A current inadequacy in fuel reprocessing facilities is due to a lack of policies and licensing requirements for such plants and the fact that a substantial corporate investment is required with a delayed recovery of such an investment. (JGB)

210 MOLTEN-SALT TRANSPORTATION AND HEAD-END OPERATIONS ON LMFBR FUEL. Heylen, P.; Claes, W.; Lecerf, H.; Van Impe, J.; De Beukelaer, R. Trans. Amer. Nucl. Soc.; 20: 629-632(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

211 CONCEPTION OF A LARGE REPROCESSING PLANT. Buck, C.; Couture, J.; Issel, W.; Manielle, J. Trans. Amer. Nucl. Soc.; 20: 634-635(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

212 CONCEPTUAL DESIGN OF A REPROCESSING PLANT FOR IRRADIATED FAST BREEDER REACTOR FUELS. Boudry, A.; Le Bouhellec, J.; Miquel, P.; Redon, A. Trans. Amer. Nucl. Soc.; 20: 635-636(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

213 OFF-GAS TREATMENT IN SPENT FUEL REPROCESSING PLANTS. Miquel, P.; Le Bouhellec, J.; Cantel, J. Trans. Amer. Nucl. Soc.; 20: 639-641(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

214 GAS PURIFICATION TECHNOLOGY FOR MINI-RELEASE IN LMFBR FUEL REPROCESSING. Collard, G.; Broothaerts, J.; Goossens, W.; Glibert, R.; De Beukelaer, R. C.; Baetsle, L. Trans. Amer. Nucl. Soc.; 20: 641-644(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

215 IN-LINE PROCESS CONTROL FOR REPROCESSING PLANTS: PRESENT STATUS AND FUTURE PROSPECTS. Edeline, J. C. Trans. Amer. Nucl. Soc.; 20: 644-645(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

CONTROLLED THERMONUCLEAR RESEARCH

Refer also to abstracts 1834 and 2167.

216 (NTIS/PS-74/131) NUCLEAR FUSION. A Bibliography with Abstracts. Report for 1971–October 1974. Grooms, D. W. (National Technical Information Service, Springfield, Va. (USA)). Dec 1974. 162p. NTIS $20.00.

This bibliography contains 146 selected abstracts of research reports retrieved using the NTIS on-line search system. The report cites research on the initiation of fusion reactions by the control of high-temperature plasmas. The bibliography covers research on the various fusion devices; e.g., tokamaks, elmax devices, and magnetic mirrors. Also included are studies on laser-induced fusion and comparisons to other energy sources. The report does not include reports solely sponsored by the Atomic Energy Commission. (GRA)

217 (SAND-75-8219) ANNOTATED BIBLIOGRAPHY OF HIGHLY IONIZED ATOMS OF IMPORTANCE TO PLASMAS. Schmieder, R. W. (Sandia Labs., Livermore, Calif. (USA)). Apr 1975. Contract AT(29-1)-789. 316p. Dep. NTIS $19.00.

A bibliography is presented of the literature on highly ionized atoms which have relevance to plasmas. The bibliography is annotated with key words, and indexed by subjects and authors. It should be of greatest use to researchers working on the problems of impurity cooling and diagnostics of CTR plasmas. (auth)

Plasma Confinement and Heating

Refer also to abstracts 291, 324, and 346.

218 (AD/A-001380) STUDIES ON HEATING OF A PLASMA BY STRONG TURBULENCE AND RELATIVISTIC ELECTRON BEAM. Final Report, 1 July 1971–30 June 1974. Wharton, C. B. (Cornell Univ., Ithaca, N. Y. (USA)). 30 Jun 1974. 40p. NTIS $3.75.

Summaries are given for the following topics: Plasma resistivity during turbulent heating; ion energy distribution for turbulent heating; saturation of turbulent heating; relativistic electron beam–diode and beam characteristics; plasma heating with foil-less diode REB; plasma heating with foil-anode diode REB; beam interaction with turbulent plasma; diagnostic developments—neutral atom beam experiments; optical line broadening; and ruby laser scattering. (GRA)

219 (AD/A-001805) OPTICAL PROPERTIES OF LASER–PLASMA INTERACTIONS. Technical Note, 8 October–2 November 1973. Wyatt, R. M. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Dec 1973. 39p. NTIS $3.75.

A two-dimensional code was written to study the optical interactions of laser beams with preformed plasmas. Specifically, simulations of CO_2 and ruby lasers beams incident upon the plasmas of exploding wires have been accomplished for different beam configurations to find the optimum configuration for plasma heating. (GRA)

220 (IPP-1/151) A HYBRID FLUID-PARTICLE MODEL FOR THE DESCRIPTION OF ION HEATING IN HIGH MACH NUMBER SHOCK WAVES. Chodura, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 23p. INIS.

7 figs.; 9 refs.

A hybrid model treating electrons as a dissipative fluid and ions as particles is used to investigate numerically the properties of high Mach number magnetoacoustic shock waves propagating perpendicular to a magnetic field. Increasing the Alfven Mach number M_A electron pressure behind the shock becomes bounded for $M_A \gtrsim 15$. Ion reflectivity α increases but stays rather small even for $M_A \to$ infinitely, $B_0 \to 0$ (i.e., $\alpha \approx 30-40\%$ for reasonable collision frequencies in the shock). Thermalization of the shock by multiple bouncing in a cylindrical tube is studied for the case where the ion gyro-radii are large compared to the tube radius. Strong damping is found leading to equilibration after about two bounce oscillations. Ion reflection during first implosion is found to be essential for nonadiabatic ion heating in the succeeding thermalization period. (GE)

221 (IPP-6/130) COLLISIONLESS PLASMA HEATING AT THE ION CYCLOTRON FREQUENCY IN A TOROIDAL DEVICE. Cattanei, G.; Croci, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 10p. (IPP-2/225). INIS.

3 figs.; 4 refs.

The R.F. power absorbed by the plasma in a toroidal device at the ion cyclotron resonance is evaluated with allowance for the effect of the rotational transform. It is found that the heating rate is by a considerable factor larger than that evaluated for purely toroidal magnetic field. (GE)

222 (ORNL-TM-4855) NEUTRAL BEAM INJECTION INTO A TOKAMAK: PARTICLE ORBIT LOSS-REGIONS IN TOKAMAKS AND THEIR EFFECTS ON PLASMA HEATING. Rome, J. A.; McAlees, D. G.; Callen, J. D.; Fowler, R. H. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 45p. Dep. NTIS $5.25.

During the slowing-down process, fast ions injected into a tokamak plasma may pitch-angle-scatter into orbits whose derivations from flux surfaces are of order a, the limiter radius. Ions on such orbits may hit the wall or limiter or be charge-exchanged out of the system and are thus in the "loss region." The boundary of this region is calculated and its effect on plasma heating by neutral beam injection is evaluated by using the Fokker-Planck equation. In present injection experiments, the loss region may have a significant effect if the impurity level of the plasma is high. Counterinjected ions are more strongly affected by the loss region than are coinjected ions since they have to scatter through a smaller pitch angle to reach it. (auth)

223 (UCRL-76529) THEORETICAL INTERPRETATIONS OF ENHANCED LASER LIGHT ABSORPTION. Kruer, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1975. 27p. (CONF-750110-6). Dep. NTIS $4.50.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

Intense laser light is not efficiently absorbed classically but can be absorbed by its conversion to electron plasma waves near the critical density. The physical mechanisms for this conversion are discussed, and some simple estimates for heating by plasma waves are applied to some recent experiments. Several effects which strongly influence the absorption of high intensity light are emphasized, including a nonlinear steepening of the plasma density profile which is demonstrated in computer simulations. Finally the possibility of an induced reflection of laser light due to instabilities in the underdense plasma before the critical density is also discussed. Such stimulated reflection can be particularly important in plasmas with very long density gradients. (auth)

224 (UCRL-Trans-10839) ELECTROSTATIC AND ELECTROMAGNETIC TRAPS FOR HIGH-TEMPERATURE PLASMA. Lavrent'ev, O. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Mar 1975. Translation of KHFTI-74-37. 41p. Dep. NTIS $5.25.

Theoretical and experimental aspects of thermal isolation are considered for a high-temperature plasma in systems with electrostatic as well as electric and magnetic fields. Specific types of traps are discussed, together with diagnostic methods and fundamental experimental results. (auth)

225 (UCRL-trans-10844) HEATING OF PLASMA IN AN EXPLOSION-COMPRESSED LINER. Churaev, V. A.; Lobanov, K. M.; Fedyakov, V. P.; Dyatlov, V. D.; Timonin, A. M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Apr 1975. Translation of Russian Preprint T-0205. 16p. Dep. NTIS $4.00.

The problem of plasma compression with a conducting liner accelerated by the pressure of explosion products was solved under the following assumptions: (1) the outer wall delimiting the explosive remains stationary, (2) the dependence of the pressure P/sub B/ on the specific volume U/sub B/ for the explosion products is described by P/sub B/ equals P/sub Bo/ (U/sub Bo//U/sub B/)^3, (3) the following equation of state was adopted for the liner metal P/sub l/ equals P/sub lo/ [(U/sub lo//U/sub l/)^4–1], (4) account was taken of bremsstrahlung and thermal conductivity along the axis, (5) it was assumed that the plasma is insulated from the liner walls by a magnetic-field layer, the thickness of which was neglected, and (6) the plasma was heated by compression with the liner and by the energy of alpha particles obtained in the fusion reaction. (MOW)

226 FAST NEUTRAL INJECTION OF A MIRROR HOT-ION TARGET PLASMA. Bir, R.; Jacquinot, J.; Leloup, C.; Poffe, J. P.; de Pretis, M. (CEN, Fontenay-aux-Roses, France). Nucl. Fusion; 15: No. 1, 17-20(Feb 1975).

The possibility of transferring a target plasma into a confinement region is considered. This method avoids the gas problem and reduction of access which are usually associated with the target production in situ. The transfer is shown to be feasible

with good efficiency at the expense of a complicated set of pulsed magnets. (auth)

227 FAST NEUTRAL INJECTION ON A MIRROR HOT-ION TARGET PLASMA. I. Plasma Parameters and Injection Requirements: General. Jacquinot, J.; Leloup, C.; Poffe, J. P.; de Pretis, M. (CEN, Fontenay-aux-Roses, France). Nucl. Fusion; 15: No. 1, 3-16(Feb 1975).

Problems related to the definition of a target plasma for fast neutral injection into a mirror machine are discussed. Plasma parameters and magnetic configuration are first examined in the light of instability theory; the study is concerned with: the required neutral beam current; the beam energy modulation connected to the evolution of the ion distribution function; the evolution of the plasma geometry associated with the vacuum requirements; and the deduction of suitable plasma parameters. This ensemble leads to the conclusions that an experiment to study the stability of mirror machines in a quasi-steady state relevant to reactor regimes is possible starting from a reasonable extension of present laboratory plasmas. (auth)

228 HYBRID FLUID-PARTICLE MODEL OF ION HEATING IN HIGH-MACH-NUMBER SHOCK WAVES. Chodura, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 15: No. 1, 55-61(Feb 1975).

A hybrid model treating electrons as a dissipative fluid and ions as particles is used to investigate numerically the properties of high-Mach-number magnetoacoustic shock waves propagating perpendicular to a magnetic field. Upon increasing the Alfven Mach number M_A, the electron pressure behind the shock becomes bounded for $M_A \gtrsim 15$. Ion reflectivity α increases but stays rather small even for $M_A \to \infty$, $B_0 \to 0$ (i.e., $\alpha = 30 - 40\%$ for reasonable collision frequencies in the shock). Thermalization of the plasma by multiple bouncing in a cylindrical tube is studied for the case where the ion gyroradii are large compared to the tube radius. Strong damping is found to lead to equilibration after about two bounce oscillations. Ion reflection during the first implosion is found to be essential for non-adiabatic ion heating in the succeeding thermalization period. (auth)

229 BOUNDED-PLASMA THEORY OF RADIO-FREQUENCY HEATING OF TOROIDAL MACHINES. Messiaen, A. M.; Vandenplas, P. E.; Weynants, R. R.; Koch, R. (Ecole Royale Militaire, Brussels). Nucl. Fusion; 15: No. 1, 75-93(Feb 1975).

A systematic study is made of the coupling of rf energy to a plasma column by means of an external set of current sources in the toroidal cavity constituted by the machine. The coil loading due to the absorption of rf power by the plasma and by the wall is discussed inside various frequency domains of interest for rf heating. The plasma is described by hot-fluid theory with effective collision frequencies; the latter are either particularized to describe analytically linear collisionless damping or used as parameters to simulate other loss mechanisms like the nonlinear ones. Boundary conditions consistent with the magnetic confinement are taken at the plasma-vacuum interface. Special emphasis is placed on the bounded-plasma effects in the entire frequency range (from $\omega \ll \omega_{ci}$ up to $\omega > \omega_{LH}$). In particular, magnetoacoustic resonances may strongly increase the efficiency of rf energy transfer when the physical absorption mechanisms are electron TTMP or ion cyclotron resonance. At higher frequency, resonance modes, of the coaxial type are found in which the plasma plays the role of the central conductor of a coaxial toroidal cavity. (auth)

230 ANOMALOUS DC RESISTIVITY AND TURBULENT ION HEATING IN ISOTHERMAL PLASMAS. Yamada, M.; Hendel, H.W.; Seiler, S. (Plasma Physics Laboratory, Princeton Univesity, Princeton, New Jersey 08540); Ichimaru, S. Phys. Rev. Lett. 34: No. 11, 650-653 (17 Mar 1975).

Anomalous resistivity and intense ion heating are observed in isothermal plasmas where ion sound is damped, concomitant with onset of resonant discrete and nonresonant continuous spectra of ion-cyclotron drift waves. These results are explained by a theory based on statistically averaged instability amplitudes and frequencies. (auth)

231 INDICATIONS OF STRONGLY FLUX-LIMITED ELECTRON THERMAL CONDUCTION IN LASER-TARGET EXPERIMENTS. Malone, R.C.; McCrory, R.L.; Morse, R.L. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New York 87544). Phys. Rev. Lett. 34: No. 12, 721-724 (24 Mar 1975).

It is shown by comparison with calculations that anomalies in the results of intense laser irradiation of solid targets, including two-humped ion distributions, indicate a reduction of electron thermal conduction to considerably below classical values. This reduction is interpreted as a flux limit and appears to be sufficiently restrictive to modify significantly the design of laser fusion targets. (auth)

232 ION ACCELERATION IN STRONG ELECTROMAGNETIC INTERACTIONS WITH PLASMAS. Wong, A.Y.; Stenzel, R.L. (TRW Systems, Redondo Beach, California 90278). Phys. Rev. Lett. 34: No. 12, 727-730 (24 Mar 1975).

Energetic ions of energy up to $7kT_e$ are detected when an inhomogeneous plasma ($T_e/T_i \simeq 10$) is irradiated by microwave pulses ($E_0^2/4\pi nkT_e \simeq 10^{-2}$) of short durations ($\tau$ approximately twice the ion-plasma period). Time- and space-resolved analyses trace their origin to the generation of density cavitons by ponderomotive forces. The axially directed energetic-ion flux carries a significant fraction of incident electromagnetic energy. (auth)

233 CRITICAL ENERGY FOR ADIABATIC RF PLUGGING. Hatori, T.; Watanabe, T. (Nagoya Univ., Japan). Nucl. Fusion; 15: No. 1, 143-150(Feb 1975).

Necessary and sufficient conditions are obtained for the description of particle motion by a "quasi-potential" in an inhomogeneous static magnetic field and an rf electric field. This analysis leads to a new concept of "critical energy," the height of the adiabatic barrier, which is proportional to $E_0^{4/5}$, E_0 being the strength of the rf field in the plasma. The theoretical results are confirmed by numerical calculations. Although this concept holds in a general magnetic field, analysis is restricted to the cusped magnetic field. (auth)

Plasma Diagnostics

234 (AD/A-000147) USING THOMSON MASS SPECTROGRAPH WITH ELECTRON-OPTICAL REGISTER FOR STUDYING ACCELERATION MECHANISM OF PLASMA CLUSTERS. Pergament, M. I.; Yaroslavskii, A. I. (FTD-HT-23-1093-74). 4 Oct 1974. Translated by M. Olaechea from pp 268-271 of Plazmennye Uskoriteli, Moscow, 1973. 12p. NTIS $3.25.

235 (AD/A-000148) INTERFEROMETRY OF DENSE PLASMA FLOWS. Andrianov, A. M.; Alekseev, Yu. A. 4 Oct 1974. Translated by M. Olaechea from pp 272-274 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1094-74). 11p. NTIS $3.25.

Results of interferometric measurements of the distribution of the electron concentration in a plasma flow obtained by means of an electromagnetic plasma accelerator with erosion of the dielectric are discussed. (GRA)

236 (FRNC-TH-501) SPECTROSCOPIC STUDY OF A LASER-INDUCED HELIUM PLASMA. Influence of Collective Effects. Experimental Demonstration of Satellite Lines of Forbidden Transitions. Bretagne, J. (Paris-11 Univ., 91 - Orsay (France)). 1973. 175p. (In French). INIS.

Thesis.

A spectroscopic study was carried out on a dense helium plasma created by focusing a laser beam. Special attention was paid to the influence of collective effects on the profiles of two partially degenerate lines of He, the 4471.5 Å and 4921.9 Å lines. The characteristics of the plasma investigated (electron density between 10^{16} and 10^{18} e/cm^3, electron temperature of a few electron volts) situate it at the limit of standard kinetic plasmas, with predominant binary collisions, and collective plasmas with coupling of atomic radiative transitions and self-excited plasma waves. The appearance of satellite lines of the forbidden transitions $4^3F \to 2^3P$ and $4^1F \to 2^1P$ was demonstrated. They correspond to the coupling of plasmons of frequency $\omega = \omega_p$ and electromagnetic waves associated with the above two forbidden transitions. The profiles observed for these satellites and the results concerning their intensity were interpreted in terms of nonthermal electrostatic fluctuations of the electron electric field. After a kinetic study of the HeI and HeII level populations it was possible to determine the influence of the various above reactions in the production of hot electrons. The superelastic collisions $He^+(2) + e \to He^+(1) + e$ are mainly predominant at the beginning of the post-discharge of the plasma. Using a Fokker-Planck model the form of the electron velocity distribution function tail was deduced and the spectrum of the collective contribution to the fluctuating field was determined. The experiment also revealed a considerable change in the profile of the two lines studied in their central part (relative intensity of the allowed component P and the forbidden component I and difference between I and P) attributable to the influence of collective effects. (INIS)

237 (UCRL-Trans-10831) USING PARTICLE BEAMS TO MEASURE PLASMA POTENTIAL. Kalmykov, A. A.; Lavrent'dv, O. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Feb 1975. Translation of KHFTI-74-17. 23p. Dep. NTIS $4.25.

A method for measuring plasma potential, the spatial distribution of plasma potential, and other parameters is considered; it makes use of beams of heavy ions and the variation in the charge composition of probe ions in the plasma. The magnitude of the plasma potential is found from the variation in charge, while the spatial distribution of potential is constructed on the basis of measurements of particle time of flight through the plasma volume. (auth)

238 (UCSD-34P221X1) EXPERIMENT TO MEASURE LOW-FREQUENCY PLASMA FLUCTUATIONS BY LARGE-APERTURE HOMODYNE METHODS. Progress Report, 1 May 1973–30 April 1974. (California Univ., La Jolla, San Diego (USA)). 1974. Contract AT(04-3)-34. 23p. Dep. NTIS $4.25.

During the initial contract period, several tasks necessary in preparation of the I.R. homodyne scattering experiment were accomplished. Development of the 10 kW, 1 msec CO_2 laser is nearly complete. A series of experiments in a test section of the electrical corona glow excitation system verified that it is possible to excite the cavity region at a 100 kW input power for a full millisecond in a static gas fill without incurring sparking or unacceptable heating, provided that the CO_2–N_2–H/sub e/ mix is correctly proportioned. The main laser frame has been constructed, and the internal optics installed and aligned. Since this experiment is designed to allow quasi-CW scattering during a millisecond of plasma on-time in order for temporal spectra to be acquired, it is necessary to provide a convenient means for spectrally analyzing the time series recorded from the scattering detector. A fast Fourier transform software package was tested that dumps the 2000-word digitized time series in a Biomation 8100 transient recorder into an IBM 1800 computer, and returns a plotted spectrum of the data with about a one-minute turnaround time. Design of the optical system that relays the laser energy into the plasma region and out again, and collects the scattered component, is proceeding at the present time. (auth)

239 ELECTRON TEMPERATURE IN A HIGH-FREQUENCY HELIUM DISCHARGE. Voitsenya, V. S.; Voloshko, A. Yu.; Konovalov, V. G.; Solodovchenko, S. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 7, 909-910(Jan 1975).

Translated from Zh. Tekh. Fiz.;44: No. 7, 1455-1457(Jul 1974).

Spectroscopic measurements of the electron temperature in a high-frequency discharge plasma ($T_e \sim 10$ eV, $n_e \sim 2 \times 10^{-3}$) in a toroidal stellarator are described. As the density of neutrals in the discharge increases one must take account of radiation trapping resonance lines. (auth)

240 COMPUTER DATA ACQUISITION SYSTEM FOR THE SANDIA FOUR-BEAM LASER. Boyer, W. B.; Davis, R. F.; Krone, J. L.; Powell, J. E. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 547-550(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Sandia four-beam laser facility is briefly described and the need for diagnostic instrumentation is discussed. The on-line computer system which supports this instrumentation is then described. Significant problems affecting the design of the instrumentation equipment are discussed, followed by descriptions of the actual equipment which has been built and the associated interfacing techniques. (auth)

241 INSTRUMENTATION FOR X-RAY DIAGNOSTIC MEASUREMENTS ON LASER-PRODUCED PLASMAS. Bardin, R. K.; Chase, L. F. Jr.; Fisher, T. R.; Jordan, W. C.; Kohler, D.; Pronko, J. G. (Lockheed Palo Alto Research Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 724-730(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A Nd-glass laser facility is described which is designed for studies of the laser-plasma interaction and for the development of special diagnostic instrumentation relevant to the problems of laser-driven fusion. The laser produces a 1-J, 200-psec pulse of 1.06-mu m radiation which is focused into a 50 to 100-mu m target spot to generate the plasma under study. An instrumentation package has been developed for performing x-ray diagnostic measurements to obtain information on plasma parameters. The package consists of a multichannel curved-crystal x-ray spectrograph (1 eV resolution at 1000 eV), calorimeters, and a fast x-ray diode (20-psec rise time) with a ten-channel single-shot sampler readout. This system records x-ray spectra, conversion efficiencies, and time histories of selected portions of the x-ray spectrum. With the integrated system, a complete set of data can be obtained on each laser shot. (auth)

242 APPLICATION OF LANGMUIR PROBES TO THE STUDY OF FLOWING AFTERGLOW PLASMAS. Smith, D.; Adams, N. G.; Dean, A. G.; Church, M. J. (Univ. of Birmingham, Eng.). J. Phys., D (London); 8: No. 2, 141-152(1 Feb 1975).

The application of the single Langmuir probe techniques to the measurement of electron number densities and temperatures in helium flowing afterglow plasmas is described. Data are presented relating to electron loss by both ambipolar diffusion and recombination, which illustrates the value and quality of the diagnostic technique. Results are also presented which illustrate how metastable atom densities can be readily determined by exploiting the Penning effect, and also probe determinations of electron temperature which demonstrate the role of metastable atoms in elevating the plasma electron temperature. In conclusion, the potential value of the probe-flowing afterglow combination is discussed with reference to the determination of positive and negative ion densities and ionic mass, of ion-molecule reaction rates and electron temperature relaxation rates. (auth)

243 ORIFICE PROBE FOR PLASMA DIAGNOSTICS. IV. Ion Density Determination. Prokopenko, S. M. L.; Goodings, J. M. (York Univ., Toronto). J. Phys., D (London); 8: No. 2, 135-140(1 Feb 1975).

The ion number density n_i is determined by the orifice probe using a method independent of the electrons. The quantities measured experimentally through the orifice are the number of ions per unit time (ion saturation current i_i) divided by the volume flow rate $\dot{V}$ of neutral gas. In the molecular flow region where $\dot{V}$ is constant, n_i is simply obtained from a measurement of i_i. The method is reliable when the random velocity distributions of the ions and neutrals remain unchanged by the sampling process, and is insensitive to the velocity distribution of the electrons. This determination of n_i is potentially adaptable to a wide pressure and density range. The method has been applied here to an RF plasma in argon with an input power of 25 W for pressures from 0.001 to 10 torr and number densities from 10^8 to 10^{11} cm^{-3}. For pressures between 0.02 and 0.2 torr, n_i obtained in this way is in good agreement with n_e obtained from the probe characteristics. This determination of n_i is much simpler and inherently more accurate (<15%) than that for n_e using the orifice probe or Langmuir probes (>20%). (auth)

244 MEASUREMENT OF THE RADIAL TEMPERATURE DISTRIBUTION OF AN ARGON DISCHARGE AT MEDIUM PRESSURES BY PULSED HOLOGRAPHIC INTERFEROMETRY. Rzhevskii, V.N. Opt. Spectrosc. (USSR) 37: No. 6, 671-672 (Dec 1974).

The radial temperature distribution of an Ar discharge was measured by the pulsed holographic interformetric technique.(AIP)

245 INVESTIGATION OF THE CONTINUOUS EMISSION SPECTRUM OF THE XENON PLASMA OF A CONTINUOUS OPTICAL DISCHARGE. Kozolov, G.I.; Kuznetsov, V.A.; Masyukov, V.A. Opt. Spectrosc. (USSR) 37: No. 6, 601-605 (Dec 1974).

The possibility of using a continuous optical discharge for detailed spectroscopic investigations is explored for the first time. The investigations were made on the continuous emission spectrum of a xenon plasma at a pressure of 2 atm, between 2500 A and 8000 A. A diagnostic investigation of the plasmoid of a continuous optical discharge is made by three independent methods. The maximum temperature (at the center of the plasmoid) is 16,000 K. The experimental data are compared with the Biberman–Norman theory for T=10,000 K. Good agreement is obtained between the experimental and theoretical values of the radiant power of the plasma over the whole wavelength range, with the exception of the boundary–frequency region (4000–5000 A). In this region the experimental values considerably exceed the theoretical values. It is suggested that this is due to overlapping of the edges of the large number of intense lines of the Xe atom that are situated in this region. This possibility is not taken into account by the theory. (auth)

246 VARIATION IN THE CONTOUR OF A RESONANCE LINE AS A FUNCTION OF PLASMA COMPOSITION. Gladushchak, V.I.; Skidan, V.V.; Shreider, E.Ya. Opt. Spectrosc. (USSR) 37: No. 6, 598-600 (Dec 1974).

Resonance line contours were investigated by the methods of line absorption and electric field scanning. It is shown that the observed broadening of the resonance lines is associated with the presence of metastable atoms and energy transfer as a result of collisions of the second kind. (auth)

247 SPECTROSCOPIC STUDY OF NONEQUILIBRIUM IN HIGHLY IONIZED HELIUM. Gruzdeva, N.S.; Nikolaevskii, L.S.; Podmoshenskii, I.V. Opt. Spectrosc. (USSR) 37: No. 6, 591-594 (Dec 1974).

Spectroscopic diagnosis was carried out, and the problems of nonequilibrium of a dense pulse–discharge helium plasma at atmospheric pressure were studied. It was determined experimentally that a stable laboratory plasma at $T_e = (3-4) \times 10^4$K and $n_e = (3.0-8.3) \times 10^{16}$ cm^{-3} is in ionization nonequilibrium. The basis reason for the collisional nonequilibrium is the radiation loss that leads to an intense repopulation of the He I ground state and to an incomplete population of this state for He III. For a plasma size of $r \geq 0.5$ cm, diffusion processes can be disregarded. The experimental results are compared with the theoretical calculations of Drawin for a helium plasma. Good agreement is found between experiment and theory. (auth)

248 A METHOD FOR MEASURING THE PHASE SHIFT OF A RADIATION AND A CORRESPONDING MEASURING DE-

VICE. Blanc, P.; Lesieur, J. P.; Veron, D. (to CEA). French Patent 2,203,974/A/. 23 Oct 1972. 25p. (In French).

A description is given for a method for measuring the phase-shift phi generated by a phase-shifting device in an electromagnetic radiation, characterized in that it comprises the steps of generating an electromagnetic wave, the angular frequency and amplitude of which are w and respectively, viz x = a cos wt; dividing said wave into two partial waves; frequency-shifting one of these two partial waves by an amount w'-w; causing the phase-shifting device to act on any of the partial waves; causing the the two frequency-and-phase shifted partial waves to beat, whereby is generated a low-frequency signal z = c. cos [(w'-v)t-phi] containing said phase-shift phi; and measuring-phase-shift phi from said low-frequency signal. The invention has many applications in particular for measuring the electron density of a plasma, for measuring refractive indices or dimensional fluctuations of workpieces, in metrology etc. (FR)

249 MEASUREMENT OF THE RADIAL DISTRIBUTION OF THE IONIZATION TEMPERATURE IN A HF PLASMA. Jarosz, J.; Mermet, J. M.; Robin, J. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). Compt. Rend., Ser. A, B; 278: No. 20, 885-888(13 May 1974). (In French).

The radial distribution of the electron density of an argon-hydrogen plasma was measured from the Stark broadening of the H(β) and argon I(5495.9 A) lines. The ionization temperature is obtained from the n(e) value by calculation using a generalized expression of Saha's law in the case of a mixture of several components in several ionization states. (FR)

Plasma Kinetics (General)

250 (AD-787338) GEOMETRICAL OPTICS OF PLASMA OPTICAL SYSTEMS. Lebedev, S. V.; Morozov, A. I. 3 Oct 1974. Translated by M. Olaechea from pp 92-96 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1054-74). 12p. NTIS $3.25.

The following are discussed: (1) it is theoretically possible to focus quasi-neutral ion beams by means of static electromagnetic fields; (2) the optical properties of plasma systems differ to a great extent from vacuum systems, which enables one to create plasma systems which have no analogs among the vacuum systems; and (3) making the force fields in plasma systems equipotential makes it possible to vary the distribution of the electrical potential in the system over broad limits, thus enabling considerable change in the optical properties. (GRA)

251 (AD-787341) TWO-STAGE ACCELERATION OF IONS IN LAYER WITH CLOSED HALL CURRENT. Erofeev, V. S.; Zharinov, A. V. 2 Oct 1974. Translated by M. Olaechea from pp 68-71 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1050-74). 12p. NTIS $3.25.

252 (AD-787349) INSTABILITY AND ANOMALOUS DIFFUSION IN HALL NONEQUILIBRIUM PLASMA SOURCE. Arefev, V. I.; Borisov, B. S. 3 Oct 1973. Translated by M. Olaechea from pp 142-144 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1065-74). 9p. NTIS $3.25.

Experiments in which the energy balance in a nonequilibrium plasma source was studied an unusually great diffusion of plasma across the magnetic field was observed. It is pointed out that the rapid drift of particles to the walls could not be explained by Coulomb collisions alone. In the present study it is proposed that this phenomenon is caused by the oscillations which develop as a result of current-dissipative instability. (GRA)

253 (AD-787353) ION ACCELERATION IN EH LAYER WITH CLOSED HALL CURRENT. Erofeev, V. S.; Zharinov, A. V. 2 Oct 1974. Translated by M. Olaechea from pp 65-68 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1049-74). 12p. NTIS $3.25.

254 (AD-787396) LOW-FREQUENCY INSTABILITY IN RADIAL ION BEAM FORMED BY EH LAYER WITH CLOSED HALL CURRENT. Erofeev, V. S.; Zharinov, A. V. 2 Oct 1974. Translated by M. Olaechea from pp 71-74 of Plazmennye Uskoriteli, 1973. (FTD-HT-1051-74). 11p. NTIS $3.25.

255 (AD-787409) QUASI-ONE-DIMENSIONAL MODEL OF PLASMA ACCELERATION IN AXISYMMETRICAL DISCHARGES WITH EXTERNAL MAGNETIC FIELD. Petrosov, V. A.; Safonov, I. B. 3 Oct 1974. Translated by M. Olaechea from pp 129-132 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1061-74). 10p. NTIS $3.25.

A quasi-one-dimensional model of an end type of low-current (Hall) plasma accelerator is studied. In this accelerator the prevailing influence is that of electromagnetic forces, and the internal magnetic field is much smaller than the external. (GRA)

256 (AD-787410) PLASMA ACCELERATORS. 2 Oct 1974. Translated by M. Olaechea from pp 1-4 of Plazmennye Uskoriteli, 1974. (FTD-HT-23-1041-74). 6p. NTIS $3.25.

The general problems of the physics of processes in plasma accelerators, peculiarities of processes in specific types of accelerators and magnetoplasma compressors, diagnostic methods of plasma flows, and the problems of applying plasma accelerators in thermonuclear studies, gas dynamics, cosmic studies, and technology are examined. (GRA)

257 (AD-787411) COMPARATIVE STUDY ON SYMMETRICAL EXH PLASMA ACCELERATOR WITH MAGNETIC QUADRUPOLE. Glazkova, P. I.; Grishin, S. D. 3 Oct 1974. Translated by M. Olaechea from pp 144-147 of Plazmennye Uskoriteli, 1973. 6p. NTIS $3.25.

The electrical discharge parameters and plasma stream characteristics at the channel output of accelerators with external magnetic fields and a magnetic field with radial and axial components were studied experimentally. (GRA)

258 (AD/A-000044) GRAZING INCIDENCE SPECTROGRAPH AS APPLIED TO VACUUM ULTRAVIOLET, SOFT X RAY, PULSED PLASMA SOURCES. Final Report, May-December 1973. Burns, E. J. T. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jul 1974. 44p. (AFWL-TR-74-121). NTIS $3.75.

A 2.2-meter variable angle of incidence grazing incidence spectrograph is described for photographic recording of spectra down to 10 A. Also a method for determining the absolute total fluence from a pulsed plasma source, knowing the absolute sensitivity of the instrument, is described. Spectra are presented from a low-inductance sliding spark gap and a 20-kJ dense plasma focus. A program for spectrum analysis is included. (auth)

259 (AD/A-000141) MAGNETIC MEASUREMENTS IN AXISYMMETRICAL STRONG-CURRENT DISCHARGE. Prikhodov, V. Yu. 4 Oct 1974. Translated by M. Olaechea from pp 139-141 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1064-74). 12p. NTIS $3.25.

260 (AD/A-000198) IONIZATION INSTABILITY OF A SELF MAINTAINED DISCHARGE IN A STRONG TRANSVERSE MAGNETIC FIELD. Erefeev, V. S.; Sanochkin, Yu. V. 13 Dec 1972. Translated from pp 24-27 of Kolebaniya I Volny V Plazme, Minsk, 1971. (FSTC-HT-23-490-73). 6p. NTIS $3.25.

261 (AD/A-000360) USE OF PLASMA ACCELERATORS IN GAS DYNAMICS. Grozdovskii, G. L. 31 Oct 1974. Translated by C. T. Ostertag, Jr. from pp 25-40 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-MT-24-1044-74). 27p. NTIS $3.75.

In contemporary gas dynamics, plasma accelerators have a determining role, since only with their help is it possible to obtain the extreme parameters of high-speed and high-temperature gas flows. The basic fields of application of plasma accelerators in gas dynamics are the high-speed wind tunnels and electroreactive motors. The specific aspects of use of plasma accelerators in these fields of gas dynamics are examined. (GRA)

262 (AD/A-000641) DISINTEGRATION OF ELECTRODES IN PULSED PLASMA ACCELERATORS. Dmitrienko, B. I.; Leskov, L. V. 23 Oct 1974. Translated by M. Olaechea from pp 225-228 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1083-74). 13p. NTIS $3.25.

The erosion of copper electrodes in pulsed plasma accelerators of conical and coaxial geometry with a solid dielectric-polytetrafluoroethylene-4-was studied. The main purpose was to establish the qualitative patterns of electrode disintegration in pulsed plasma accelerators. (GRA)

263 (AD/A-000642) SECTION SEVEN. Calculational Methods and Theory of Near-Electrode Boundary Layers. Calculating Two-Dimensional Nonstationary Plasma Flows in Channels; Dimensional Nonstationary Plasma Flows in Channels. Morozov, A. I.; Paleichik, V. V. 22 Oct 1974. Translated by M. Olaechea from pp 251-254 of Plazmennye Uskoriteli, Moscow, 1973. 12p. NTIS $3.25.

Results are presented from numerical research on the so-called compression plasma flows in coaxial channels, i.e., flows during which intensive constriction of the plasma on the channel axis is observed. (GRA)

264 (AD/A-000643) STUDY OF ABLATION OF DIELECTRIC BY SLIDING DISCHARGE IN PULSED ACCELERATORS. Dmitrienko, B. I.; Leskov, L. V. 22 Oct 1974. Translated by M. Olaechea from pp 230-233 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1085-74). 11p. NTIS $3.25.

To understand the physical processes which occur in pulsed plasma accelerators the disintegration characteristics of the plasma-forming dielectric must be understood. Experimental studies were conducted on accelerators having conical and coaxial electrode geometry. (GRA)

265 (AD/A-003077) APPLICATION OF PLASMA ACCELERATORS IN THERMONUCLEAR RESEARCH. Demidenko, I. I.; Lomino, N. S. 20 Nov 1974. Translated from pp 282-301 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HC-23-1097-74). 34p. NTIS $3.75.

The problem of transporting plasma flux produced by plasma accelerators is very important. Magnetic fields of various structures are used as plasma guides. Problems of the stability of plasma flux during transport of the plasma by a multipole field are discussed. (GRA)

266 (IPF-74-1) EXPERIMENTAL STUDY OF THE OPERATING CHARACTERISTICS OF A PLASMA FOCUS. Rapp, H. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Plasmaforschung). Jan 1974. 119p. (In German). INIS.

In the present work, a report is given on the construction of a 60 kJ plasma focus plant of the Mather type to produce a deuterium plasma with fusion conditions. The advantages of a plasma focus arrangement compared to the linear z-pinch are explained and problems discussed resulting from the cooperation of energy storage and plasma accelerators. The description of a few typical difficulties and their elimination is given. From the photographic observation of the acceleration and compression procedure, important information regarding configuration, structure and velocity of the plasma is obtained which is completed by magnet probe measurements of the current course. The further observations concern the neutron yield, the neutron flux anisotropy and the neutron spectrum. (auth)

267 (JINR-P11-8435) COMPUTER SIMULATION OF GAS FOCUSING OF RELATIVISTIC ELECTRON BEAM AND THE PROBLEM OF MOTION STOCHASTIZATION IN NONLINEAR SYSTEMS. Gazetova, A. M.; Katyshev, Yu. V.; Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The finite-size particle method was used for computer simulation of gas focusing of relativistic electron beams. The results obtained led to the conclusion that energy redistribution occurs in the considered self-consistent nonlinear nondissipative system between degrees of freedom which is in accordance with the Fermi hypothesis. (auth)

268 (UCID-16750) QUALITATIVE ASPECTS OF PHASE MODULATION IN SELF-INDUCED TRANSPARENCY. Harney, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Mar 1974. 25p. Dep. NTIS $4.25.

It is shown that retention of terms previously considered negligible in the equations of self-induced transparency invariably leads to phase-modulated solutions. The presence of this phase modulation will modify the propagation characteristics of the laser pulse and may cause the 2pi hyperbolic secant pulse to become unstable. It is also shown that the initial magnitude of the phase modulation is much less than the pulse bandwidth and that the area theorem of McCall and Hahn is approximately valid for propagation through distances less than $\text{omega}_0 T^*_2/\text{alpha}$. In this context, it may be concluded that the original results of McCall and Hahn are sufficient to describe most situations of experimental interest. (auth)

269 UHF DISCHARGE IN A QUASI-OPTICAL RESONATOR. Vikharev, A. L.; Eremin, B. G. (Scientific-Research Inst. of Radiophysics, Gorky, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 2, 452-455(Feb 1975). (In Russian).

An uhf discharge in air in a quasi-optical cavity is investigated experimentally at pressures $0.1 \leq p \leq 400$ torr. The pressure dependence of the breakdown field thus obtained is compared with the calculated dependence. The electron concentration in the discharge plasma and plasma decay time on termination of the uhf pulse are determined by the resonator method. (auth)

270 RELAXATION OF ELECTRON DISTRIBUTION OF A PARAMETRICALLY UNSTABLE PLASMA LOCATED IN A STRONG ELECTROMAGNETIC FIELD. Andreev, N. E.; Silin, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 518-529(Feb 1975). (In Russian).

It is demonstrated that under conditions of resonance between the frequency of an intense ($E_0^2 \gg 4\pi n_e T_e$) external radiation and the electron Langmuir frequency an anisotropy of electron velocity distribution occurs. After a certain time the anisotropy is characterized by the energy of motion of electrons perpendicular to the electric vector of the pumping field exceeding that of parallel motion minus the oscillations in the pumping wave. The law of variation of the longitudinal and transverse electron energies can be determined by taking into account the effect of electron redistribution on development of parametric instability. Moreover, the causes of formation of inverse anisotropy after sufficiently large periods of time can be elucidated. In the limit of a large difference between the longitudinal and transverse energies which corresponds to one-dimensional relaxation, the time-dependent electron distribution function is found. (auth)

271 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 2, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 56p.

272 TIME-DEPENDENT SPEED DISTRIBUTIONS OF ELECTRONS IN A FIELD IN A GAS. Notes on the Preservation of the Delta Form. Braglia, G. L. (Univ., Parma, Italy). Nuovo Cim.; 25B: No. 1, 479-494(11 Jan 1975).

When studying unsteady-state processes relevant to electrons in a field in a gas, it is often assumed, incorrectly, that an initial delta distribution preserves its form during the relaxation process. The exact conditions for the preservation of the delta form are given. Moreover, it is shown that the temporal behavior of any given moment of the true electron speed distribution P(v,t) may also be exactly described by replacing P(v,t) with an appropriate delta-function if the moment relaxes according to a simple exponential law. In the case of electrons in a gas in a field this happens for the second moment of P(v,t) only if the electron collision frequency is v-independent. The true distribution P(v,t) maintains its (initial) delta form during the relaxation process if and only if the electrons move in a cold gas in the absence of fields of force. The equations commonly used in practice for the calculation of the stationarization time are discussed in the light of these results. (auth)

273 GENERATION OF NEGATIVE ION-RICH PLASMA IN ELECTRO-NEGATIVE GASES (OXYGEN). Bacal, M.; Doucet, H. J. (Ecole Polytechnique, Paris). Vacuum; 24: No. 11/12, 595-600(Dec 1974).

From conference on negative ions; Liverpool, Eng. (17 Apr 1974).

This study investigated the electron (n_e), negative ion (n_-) and positive ion (n_+) densities produced by electron attachment in oxygen at low pressure (10^{-3} torr), and the factors limiting the achievement of very low β (relative electron density $\beta = n_e/n_+$). It is shown experimentally that it is possible to produce plasma with a high proportion of negative ions ($n_-/n_+ \geq 90\%$) and a low proportion of electrons, at densities n_+ up to 5×10^9 cm^{-3}. The characteristic negative ion species present in the oxygen plasma are: O^-, O_2^-, O_3^-; their production is discussed in terms of two-body processes in oxygen with an ozone additive. The comparison of mass spectrometric data with kinetic calculations shows that in small plasma diffusion losses of "free" ions affect the β values obtained at low ion density, but due to the presence of "trapped" negative ion species, the loss of negative ions by mutual neutralization controls the β values down to very low densities. (auth)

Plasma Kinetics (Experimental)

274 INVESTIGATION OF THE EQUILIBRIUM IN A DOUBLY IONIZED ARGON PLASMA. Gruzdeva, N.S.; Nikolaevskii, L.S.; Podmoshenskii, I.V. Opt. Spectrosc. (USSR) 37: No. 5, 574-576 (Nov 1974).

Thermodynamic equilibrium was investigated in a plasma of doubly ionized Ar at a pressure of 0.1 atm. (AIP)

275 INFLUENCE OF THE PENNING EFFECT ON ELECTRON–ION RECOMBINATION IN A HELIUM ARC PLASMA. Aleksandrov, V.Ya.; Gurevich, D.B.; Mikhailov, A.B.; Podmoshenskii, I.V. Opt. Spectrosc. (USSR) 37: No. 5, 489-491 (Nov 1974).

The decay of a helium arc plasma at atmospheric pressure with 0.01% hydrogen impurity is investigated. The parameters of the plasma after switching off the arc current are $n_e = 3 \times 10^{14}$ cm^{-3} and $T_e \simeq T_a = 4500$ K. It is shown that when the plasma decays, ions of helium are converted into hydrogen ions by the Penning reaction, with subsequent recombination of the hydrogen ions by triple collisions. The rate constant of the reaction $He^*(n = 2) + H \rightarrow He + H^+ + e$ is estimated and turns out to be $K = 2 \times 10^{-9}$ cm^3 sec^{-1}. (auth)

Plasma Kinetics (Theoretical)

Refer also to abstract 322.

276 (AD/A-000533) THEORY OF PLASMA KINETICS, SCATTERING OF ELECTROMAGNETIC WAVES BY PLASMAS, AND THE DYNAMICS OF PARTICLES AND ATOMS. Technical

Summary Report. Watson, K. M.; Mandelstam, S. (California Univ., Berkeley (USA). Dept. of Physics). 19 Aug 1974. Contract F44620-70-C-0028. 15p. (AFOSR-TR-74-1672). NTIS $3.25.

A summary is given of work performed during the last year. The chief topics were: atomic physics (scattering cross sections; multi-photon transition); plasma physics (nonlinear interaction; laser heating; interaction of strong electromagnetic waves); elementary-particles physics (dual models; gauge models; current algebra). (GRA)

277 (BUM-47) PROCEDURE TO SOLVE THE FOKKER–PLANCK–POISSON EQUATIONS CONSISTENTLY. Espedal, M. S. (Bergen Univ. (Norway)). Apr 1974. 33p. INIS.

A procedure for solving the Fokker–Planck–Poisson equations is given, which takes into account wave–particle and wave–wave interactions to a certain order. In the collisionless case equations similar to those using other methods are obtained. (auth)

278 (COO-2218-26) IONIZATION AND CHARGE EXCHANGE RATE COEFFICIENTS FOR CTR CALCULATIONS. Miller, R. L.; Miley, G. H. (Illinois Univ., Urbana (USA)). 29 Jan 1975. Contract AT(11-1)-2218. 32p. Dep. NTIS $4.75.

Microscopic collisional ionization and charge exchange cross sections for neutral, hydrogenic atoms in CTR plasmas are averaged over plasma phase-space distribution functions to obtain (sigmav) rate coefficients. Prior calculations of this type were restricted to isotropic plasma distributions with injection at an energy near the mean plasma energy, however, in the present case, mirror loss-cone distributions are allowed. A discussion of methods and exemplary results in the energy range [0.1 to 300 keV] are presented. (auth)

279 (IPP-2/222) ELONGATED THREE-BOUNDARY AXISYMMETRIC EQUILIBRIA. Barberio-Corsetti, P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). May 1974. 10p. INIS.

The MHD equilibria of axially symmetric, current-carrying low-β plasmas with non-circular cross-section are investigated. The appropriate boundary conditions are imposed by solving a self-consistent free-boundary problem in the approximation of a thin, vertically elongated, otherwise arbitrary cross-section. The plasma boundary determines the external currents or vice versa. (auth)

280 (JINR-P11-8306) HARDWARE FOR NUMERICAL SIMULATION OF THE ELECTROMAGNETIC WAVE INTERACTION WITH CHARGED CLUSTERS IN A CYLINDRICAL WAVE GUIDE. I. The Program of Tabulation of Cylindrical Function and Their Derivatives (STORE). The Program of Tabulation of Integrands (PRODUCT). Zhidkov, E. P.; Shvachka, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A set of programs is described intended for numerical simulation of the electro-magnetic wave interaction with the charged clusters in a cylindrical wave guide. The program STØRE is intended for tabulation of cylindrical functions of the first type and their derivatives up to the second order inclusively. The program PRØDUCT forms the Bessel function products and their derivatives for given values of indices. The results of the program PRØDUCT are used in the scattering integral calculation. (auth)

281 (JINR-P11-8307) HARDWARE FOR NUMERICAL SIMULATION OF THE ELECTROMAGNETIC WAVE INTERACTION WITH CHARGED CLUSTERS IN A CYLINDRICAL WAVE GUIDE. II. The Program of Calculation of the Scattering Integrals (MAIN). The Program of Numerical Integration of a System of Linear Differential Equations for Amplitudes (PARAMP). Zhidkov, E. P.; Shvachka, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A set of programs is described intended for numerical simulation of the electromagnetic wave interaction with the charged clusters in a cylindrical waveguide. The program MAIN calculates the integrals from the product of cylindrical functions and their derivatives on some weight function. The program PARAMP is intended for numerical integrating the system of linear differential equations for amplitudes. (auth)

282 (NP-20279) PROCEDURE TO SOLVE THE FOKKER-PLANCK–POISSON EQUATIONS CONSISTENTLY. Report No. 47. Espedal, M. S. (Bergen Univ. (Norway). Dept. of Applied Mathematics). Apr 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

A procedure to solve the Fokker–Planck–Poisson equations is given, taking into account wave–particle and wave–wave interaction to a certain order. The collisionless case was considered. (auth)

283 (ORNL-TM-4839) NEOCLASSICAL TRANSPORT THEORY OF A MULTISPECIES PLASMA IN THE LOW COLLISION FREQUENCY REGIME. Hirshman, S. P.; Sigmar, D. J.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 113p. Dep. NTIS $8.75.

A comprehensive neoclassical transport theory is presented for a plasma comprised of an arbitrary number of ion species in the low collision frequency banana regime. Using approximate collision operators, expressions correct to first order in (r/R)/sup ½/ are derived for the radial particle and heat fluxes (in terms of the particle density and temperature gradients) as well as the electric current, which is driven by an induced electric field and by the pressure gradients. The conservation equations for particles, toroidal angular momentum and energy are obtained from appropriate moments of the drift kinetic equation and are interpreted in terms of the guiding center motion. For the specific case of two ion species, the fluxes are explicitly evaluated over the entire range of impurity strength alpha equals n/sub Z/Z^2/ n/sub i/Z/sub i/^{2} and the complete set of moment equations determining the time evolution of the flux surface averaged density and temperature profiles are written out in detail. This allows immediate application of the results in plasma simulation codes. (auth)

284 (UCB-34P128X4) PLASMA COMPUTATIONAL PHYSICS. [Progress Report]. Birdsall, C. K. (California Univ., Berkeley (USA). Electronics Research Lab.). 8 Nov 1974. Contract AT(04-3)-34. 23p. Dep. NTIS $4.25.

The research effort is described in terms of the following projects: (a) reduction of the grid effects in simulation plasmas, (b) heating of magnetized plasmas by a large-amplitude low-frequency electric field, (c) ion cyclotron effects on the modified-two-stream instability, (d) diffusion across B, and (e) noise suppression of instabilities. Some existing projects, with the next steps planned are as follows: (a) drift cyclotron loss-cone instability with a steep density gradient, (b) non-physical effects of finite numbers of particles in quiet-start computer simulations, (c) diffusion across B with external wave and coulomb collision operator, and (d) plasma simulation handbook. Brief discussions are given for each. (MOW)

285 STABLE SHEATH THICKNESS IN COLLISIONLESS HIGH-BETA PLASMAS. Hamasaki, S.; Davidson, R. C.; Krall, N. A.; Liewer, P. C. (Univ. of Maryland, College Park). Nucl. Fusion; 15: No. 1, 27-33(Feb 1975).

Fluid-numerical studies were carried out to investigate the scaling of the stable magnetic sheath thickness ΔL_s with β, T_e/T_i, n_0, etc., in a collisionless finite-β plasma column. The system is initially close to a two-fluid equilibrium with sheath width ΔL sufficiently narrow for the azimuthal current to trigger various cross-field instabilities (ion acoustic, modified two-stream, Buneman). The enhanced field fluctuations in the sheath region, in addition to heating the plasma locally, leads to a decrease in azimuthal current and a corresponding increase in sheath width to some stable value ΔL_s, achieved as the system stabilizes and the field level saturates. The final sheath width in the numerical studies agrees well with the theoretical estimate. (auth)

286 NUMERICAL SOLUTION OF THE MHD EQUILIBRIUM EQUATION FOR AN AXIALLY SYMMETRIC FREE-BOUNDARY PLASMA IN A TORUS WITH ARBITRARY CROSS-SECTION. Cenacchi, G. (CNEN, Bologna); Taroni, A.; Sestero, A. Nuovo Sim.; 25B: No. 1, 279-294(11 Jan 1975).

A numerical method is presented for solving the MHD equilibrium equation for free-boundary plasmas in axially symmetric toroidal configurations, with an arbitrary cross-section of the external conducting casing. Magnetic fields produced by currents in axially symmetric external conductors are taken into account. It is shown that the method can also be applied when a limiter is present in the plasma chamber. (auth)

287 FREE BOUNDARY TOKAMAK EQUILIBRIUM. Grad, H.; Kadish, A.; Stevens, D. C. Contract AT(11-1)-3077. Commun. Pure Appl. Math.; 27: 39-57(1974).

The behavior of a tokamak plasma which is not confined inside a conducting shell was studied. To assess the effect of having no conducting shell, the problem is idealized to one in which the shell is completely removed. The effect of an imposed uniform vertical field on the plasma equilibrium was then studied. An analytical solution is derived using the two following assumptions: (1) that plasma currents are concentrated at the edge of the plasma in a sharp interface with constant plasma pressure inside and vacuum fields both inside and outside the plasma, and (2) the toroidal configuration is replaced with a straight one in which the axis is replaced by a plane of symmetry, and the op-

posite side of the torus is replaced by an image of the discharge. (MOW)

288 STATISTICAL MECHANICS OF DENSE IONIZED MATTER. III. DYNAMICAL PROPERTIES OF THE CLASSICAL ONE-COMPONENT PLASMA. Hansen, J. (Laboratoire de Théorie des Liquides, Université de Paris VI, 4 Place Jussieu, Paris, France); McDonald, I.R.; Pollock, E.L. Phys. Rev. A 11: No. 3, 1025-1039 (Mar 1975).

We present extensive molecular-dynamics (MD) computations of the time-dependent correlation functions of the classical one-component plasma over a wide range of thermodynamic states characterized by the dimensionless parameter $\Gamma = e^2/ak_BT$, where a is the ion-sphere radius. The computed velocity autocorrelation functions exhibit marked oscillations for $\Gamma \gtrsim 10$ at a frequency close to the plasma frequency, showing the existence of strong coupling between single-particle and collective modes; this is confirmed by a standard memory-function analysis. The dynamical structure factor consists of very sharp peaks near the plasma frequency, up to wave vectors of order $1/a$. The resulting dispersion curve exhibits negative dispersion for $\Gamma \gtrsim 3$. A simple memory-function analysis reproduces the MD data very well. At $\Gamma = 152.4$ our computations also provide evidence of well-defined shear modes. For large wave vectors a second, high-frequency transverse mode appears. From the correlation functions we have finally extracted estimates of the diffusion constant and the coefficient of shear viscosity. Near crystallization the shear viscosity has value which is unusually large compared with that of simple liquids near the triple point. (auth)

289 STIMULATED LIGHT ECHO AND INELASTIC COLLISIONS OF PARTICLES IN A LOW-TEMPERATURE PLASMA. Nefedev, L.A.; Samartsev, V.V. Opt. Spectrosc. (USSR) 37: No. 6, 673-674 (Dec 1974).

Inelastic collisions in a plasma have been investigated by stimulated light echo.(AIP)

Plasma Production

290 (ERDA-28) FINAL REPORT OF THE SPECIAL LASER/FUSION ADVISORY PANEL. (Energy Research and Development Administration, Washington, D.C. (USA)). 31 Jan 1975. 14p. Dep. NTIS $4.00.

The panel agreed on seven findings and recommendations on laser fusion. The recommendations are summarized. The potential payoffs and technical status of laser fusion are discussed. The panel agrees that the research program deserves more and broader support. Some of the difficulties of the program are described. (MOW)

291 (N-74-32185) GENERATION AND HEATING OF PLASMAS THROUGH ABSORPTION OF INTENSIVE LASER BEAMS. Boegershausen, W.; Vesper, R. Translated from Spectrochim. Acta, Part B; 24: 103-116(1969). 23p. (NASA-TT-F-15894). NTIS $4.25.

The conditions for producing laser plasmas for spectrochemical analysis are discussed using a simplified model. This model is compared with experimental observations on plasmas generated by focused radiation of lasers operated in the normal non-Q-switched as well as in the Q-switched mode. Several materials were investigated (C, Al, Fe, Zn, W, and Pb) and measurements of the total amount of material being produced by the laser beam, of the kinetic energies of the plasma particles expanding in vacuum, and of the excitation temperature were made. In addition, time-resolved observations were made. Plasmas produced by normal mode laser pulses exhibited excitation temperatures of 4900°K (C) up to 7900°K (W), while those produced by a series of giant pulses had temperatures up to 12,000°K (Fe). In the latter case, average particle energies of about 3.5 eV were measured under the same conditions. (auth)

292 (SAND-74-5293) NANOSECOND PULSE RADIOGRAPHY FOR E-BEAM TARGET INTERACTIONS. Kuswa, G. W.; Chang, J.; Widner, M. M.; Clauser, M. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 28 Oct 1974. 11p. (CONF-741079-15). Dep. NTIS $4.00.

From 16th annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

Flash x-radiographs of the outside regions of targets driven by intense electron beams were obtained at various times after irradiation. Comparisons of the dynamic behavior of these targets were made with computer simulations. A unique x-ray camera system which is unaffected by x-rays from the e-beam target interaction is described. This camera can be gated on in coincidence with a weak flash x-ray source at various times after target irradiation. (auth)

293 (UCRL-74927) INVESTIGATION OF THE EFFECTS OF SELF-GENERATED MAGNETIC FIELDS ON THE IMPLOSION OF DT SPHERES. Dahlbacka, G. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Oct 1973. 15p. (CONF-731009-13). Dep. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Self-generated magnetic fields are believed to be produced primarily by nonzero cross products in the thermoelectric gradients of the plasma that are present when a laser target is nonuniformly irradiated. Other sources for self-generated fields are direct radiation production. Two-dimensional calculations of an irradiated sphere are presented. The effect of the magnetic field on the hydrodynamic implosion is discussed in terms of the transport of energy across the field lines and on ablation pressures at various places on the pellet thereby allowing signals from regions of varying pressure to arrive too early or late. (MOW)

294 (UCRL-74928) EFFECT OF A SUPERTHERMAL ELECTRON TAIL ON THE YIELD RATIO OBTAINED FROM DT TARGETS ILLUMINATED WITH A SHAPED LASER PULSE. Lindl, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Oct 1973. 22p. (CONF-731009-14). Dep. NTIS $4.25.

From Annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

The possibility of achieving super-high compression of a bare drop of thermonuclear fuel using a shaped laser pulse depends sensitively on the electron distribution produced when the laser is absorbed. Particle simulation results indicate that laser energy absorbed near the critical density by parametric decay instabilities produces a long energetic tail of electrons which can be fit by an exponential of the form EXP(- 1/2mv^2/alphaKT/sub e/) where alpha is typically about 12 and T/sub e/ is the temperature of the background electrons. The yield from a given size pellet is sensitive both to the energy in the tail and to the slope of the tail as determined by alpha. This paper presents calculations of the optimized yield ratio for various alpha's and for varying fractions, f, in the tail for a target which is a 60 mugm sphere of D-T. With an isotropic source of hot electrons produced in the absorption process, for alpha equals 24, the worst case for this target, somewhat better than breakeven is achieved with 100 kilojoules of input energy and 30 percent of the laser energy in a superthermal tail. With alpha equals 6, about 5 times breakeven is achieved with an input of 150 kJ and all of the laser energy in a superthermal tail. For comparison, when all of the energy is deposited into a inverse bremsstrahlung spectrum, the same target yields 2.2 megajouls with an input of 46 kilojoules. (auth)

295 (UCRL-76477) EFFECTS OF FLUID INSTABILITIES ON LASER FUSION PELLETS. Mead, W. C.; Lindl, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. 36p. (CONF-750110-7). Dep. NTIS $5.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

A direct two-dimensional simulation method for fluid flow and plasma physics was used. The computer code LASNEX models the plasma phenomena of laser light absorption by inverse bremsstrahlung and plasma instabilities; energy transport and partition, using flux-limited diffusion and separate ion, electron, and radiation temperatures; and, optionally, effects of multigroup photon and particle transport and magnetic field physics. The fluid dynamics itself is Lagrangian, with an equation of state used to determine pressure, energy, and opacity as a function of density and temperature. Thermonuclear burn of compressed matter is included to permit evaluation of output to input energy ratios. The code tests with anomalies are described. Current understanding of fluid instability in the presence of ablation is discussed. (MOW)

296 (UCRL-Trans-10828) LASER-INDUCED NUCLEAR FUSION WITH MICROFISSION CONFIGURATIONS. Leuthaeuser, K. D. Translated from Atomkernenergie; 24: No. 3, 193-195 (1974). 12p. Dep. NTIS $4.00.

To increase the efficiency of laser-induced nuclear fusion, F. Winterberg has proposed nuclear-fission triggers involving small plutonium spheres of more than 100 times normal density. The characteristic properties of superdense fission configurations are evaluated (expansion through applied pressure and fission-energy release, triggering instant and probability), and the resulting physical problems are discussed. (auth)

297 (USCL-1016X1) STUDY OF HIGH DENSITY, HIGH ENERGY PLASMA PRODUCING METHODS AND PHYSICAL PROPERTY MEASUREMENTS FOR THERMONUCLEAR REACTIONS. Progress Report. (USAEC San Francisco Operations Office, Calif.). 1974. 9p. Dep. NTIS $4.00.

This research program includes two separate tasks for the advancement and understanding of the experimental techniques in high density plasma production and physical property measurements and theoretical analysis and extrapolation of the pres-

ent experimental results. Most of the research was devoted to the understanding of the deflagration process and gas-embedded Z-pinches in preparation for the upcoming experimental program. It was also discovered that 10^{14} neutrons/pulse could have been produced in past Z-pinch experiments. This was concluded also by Lawrence Livermore Laboratory's radiation safety group. (MOW)

298 (WASH-1363) AEC LASER AND ELECTRON-BEAM PROGRAMS, FY 1976 - FY 1980. (USAEC, Washington, D. C.). 15 Jul 1974. 28p. Dep. NTIS $4.00. GPO $1.20.

The goals and objectives of the laser fusion and electron-beam fusion programs are described. The significant accomplishments to date, the technical plan, required resources, and activities outside the AEC are discussed. (MOW)

299 STATUS OF LASER-FUSION RESEARCH. Boyer, K. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 38-44(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The use of lasers to initiate fusion of the heavy isotopes of hydrogen for production of commercial electric power has been under investigation for the past five years at a significant level. While some problems have been identified, a great deal of progress has been made including the observation of substantial compression. The present outlook is promising and the laser technique now is recognized as a possible alternate to magnetic containment techniques for fusion power applications. (auth)

Plasma Stability

300 (AD-787347) EFFECT OF INSTABILITIES DEVELOPING IN DISCHARGE IN CROSSED E AND H FIELDS OF NEAR-ANODE POTENTIAL JUMP. Vaulin, E. P.; Guslyakova, N. F. 3 Oct 1974. Translated by M. Olaechea from pp 150-153 of Plazmennye Uskoriteli, 1973. (FTD-HT-23-1068-74). 11p. NTIS $3.25.

301 (AD/A-000540) STUDY OF THE MHD INSTABILITIES OF A CYLINDRICAL BELT PINCH USING THE FINITE ELEMENT METHOD. Gardner, L. R. T.; Gardner, G. A. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). 25 Jul 1974. Contract F44620-73-C-0016. 22p. (UNICP-SR-103; AFOSR-TR-74-1711). NTIS $3.25.

The hydromagnetic stability of a cylindrical pinch of rectangular cross section was studied numerically using the finite element method. The plasma was subdivided into a number of rectangular elements within each of which the perturbations were expressed in terms of nodal values which are taken as parameters of a Lagrangian. Minimizing the Lagrangian with respect to these variables produces an eigenvalue problem. The stability of the pinch was determined from the eigenvalues. (auth)

302 (LRP-87/74) THALIA: A ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC STABILITY PROGRAM USING THE METHOD OF FINITE ELEMENTS. Appert, K.; Berger, D.; Gruber, R.; Troyon, F.; Roberts, K. V. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Oct 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

The linearized ideal one-dimensional MHD equations are treated in variational form by the method of finite elements. In order to describe certain features of the problem with sufficient accuracy, e.g., a displacement vector which satisfies div $\vec{\xi} \approx 0$ for the fixed boundary case, a rather general transformation is performed and the basis functions were chosen from a class able to represent div $\vec{\xi} = 0$ everywhere. The eigenvalue problem $Ax = \omega^2 Bx$ is solved by SIVI, a subprogram of the band matrix library HYMNIA. (auth)

303 (UCID-16734) HOSE INSTABILITY AT ARBITRARY CONDUCTIVITY. Lee, E. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Mar 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.00.

A model is developed for studying the dynamics of a low-current, highly relativistic beam propagating in a conducting medium. Here the conductivity (sigma) is of arbitrary magnitude, the usual assumption being that the scale beam radius (a) is small compared with the magnetic skin length (4 pi sigma a^2/c). A dispersion formula for the hose instability is derived for the case of uniform sigma and Bennett current profile J/sub b/(r) varies as $(a^2 + r^2)^{-2}$. The peak growth rate at fixed laboratory position, maximized with respect to sigma as well as driver frequency, is approximately 0.465 c/a. This growth rate is realized when 4 pi sigma a/c equals root 12/5. (auth)

304 ABSOLUTE INSTABILITY OF FOCUSED WAVES IN A PLASMA. Erokhin, N. S.; Moiseev, S. S.; Mukhin, V. V. (Ukrainian Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 68: No. 2, 536-546(Feb 1975). (In Russian).

The absolute instability of focused waves due to locking of growing oscillations is considered in the focus region of the pumping wave. The effect of two-dimensional inhomogeneity of the focused pumping wave on development of parametric instability was investigated. (auth)

305 KINETIC INSTABILITY OF A TWO-COMPONENT PLASMA AT THE GYROFREQUENCY HARMONICS. Zlotnik, E. Ya. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 18: No. 1, 5-16(1975). (In Russian).

The kinetic instability of cyclotron waves is considered in a two-component medium consisting of a weakly anisotropic equilibrium plasma and rarefied component with electrons nonequilibrium over transverse momenta. The instability criteria and the wave increments are obtained. Their dependence on the wave and plasma parameters is investigated. It is shown that the greatest enhancement is typical for cyclotron waves propagating perpendicularly to the magnetic field. In this region the appearance of the kinetic instability is due to the relativistic dependence of the electron mass on velocity. (auth)

306 NONLINEAR SATURATION OF THE TRAPPED-ION MODE. LaQuey, R. E.; Mahajan, S. M.; Rutherford, P. H.; Tang, W. M. (Princeton Univ., NJ). Phys. Rev. Lett.; 34: No. 7, 391-394(17 Feb 1975).

A nonlinear model of the collisional trapped-ion mode is presented, in which the energy in long-wavelength instabilities is transferred to short-wavelength modes which are then damped by ion-bounce resonances. Near marginal stability, the saturation of a single unstable Fourier mode is computed. Far from marginal stability, steady-state nonlinear solitary waves containing many Fourier modes are found. Particle transport is estimated in both cases. (auth)

307 POTENTIAL INSTABILITIES OF COLD PLASMA WITH THE PRESENCE OF HOT ION GROUP WITH ANISOTROPIC VELOCITY DISTRIBUTION. Bondarenko, V. I.; Makarenko, V. M.; Yukhimuk, A. K. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 198-203(Mar 1975). (In Ukrainian).

Kinetic instability was studied analytically for fluctuations of three-component plasma (cold electrons and ions and hot ions). A model function in which the anisotropy of temperatures and of the loss cone is taken into account was chosen as a hot ion distribution function. The results obtained are used to interpret certain geophysical phenomena which are observed by means of cosmic apparatuses. (auth)

308 HIGH-BETA STELLARATOR EXPERIMENTS ON ISAR T1. Fuenfer, E.; Kaufmann, M.; Lotz, W.; Neuhauser, J.; Schramm, G.; Seidel, U. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 15: No. 1, 133-142(Feb 1975).

Experiments with the first complete high-β stellarator torus with helical magnetic axis are reported. The Garching 2.6-MJ capacitor bank was used to feed a toroidal theta coil with a major diameter of 2.7 m (ISAR T1). Toroidal equilibrium was achieved by superposing helical l = 1 and l = 2 (partly also l = 0) fields on the slender ($A = R_T/r_b \approx 150$) toroidal pinch plasma such that the plasma surface facing the torus center was more corrugated than the outer side (M-and-S effect). The toroidal equilibrium condition and the corresponding plasma distortions were consistent with sharp-boundary-model predictions. Effects in connection with initial dynamics, toroidal plasma currents and transverse magnetic fields could be explained by simple models. In agreement with sharp-boundary theory, short wavelength m = 1 and m = 2 modes were found to be stable and long wavelength m = 1 modes were unstable, limiting the plasma life-time by wall contact. Long-wavelength $m \geq 2$ instabilities were not observed in contrast to sharp-boundary theory, i.e., this model is much too pessimistic for $m \geq 2$ modes, even if the finite gyroradius is included. No significant difference in the stability behavior was found, compared with previous linear and toroidal sector experiments. (auth)

309 EFFECT OF FINITE LARMOR RADIUS ON THE INTERCHANGE INSTABILITY IN A CYCLINDRICAL PLASMA. Stringer, T. E. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 1, 125-131(Feb 1975).

The eigenvalue equation for the interchange instability is derived from guiding-center equations including finite-Larmor-radius corrections. Analytic solutions are found which are valid near the $\vec{k} \cdot \vec{B} = 0$ surface and away from this surface. Matching these two solutions over their common range of validity determines the eigenvalue and hence the mode frequency. The growth rate and radial profile of the mode may readily be evaluated explicitly. The analysis is applicable to the high-β pinch, since cylindrical effects

dominate over toroidal. For typical parameters, FLR stabilization is found to increase the marginally stable pressure gradient by a factor of two over that given by the Suydam criterion. (auth)

310 WAVE PACKET DESCRIPTION OF INHOMOGENEOUS PLASMA INSTABILITIES. Lau, Y. Y. (Massachusetts Inst. of Tech., Cambridge); Briggs, R. J. Nucl. Fusion; 15: No. 1, 103-124(Feb 1975).

A linear description of the temporal evolution of a localized wave packet in a weakly inhomogeneous plasma is derived by expanding the spatial variations in the plasma parameters up to second order. The solution applies to systems with or without unstable normal modes, and it can provide a quantative measure of the correlation length of the fluctuations to be expected, as exhibited by the spreading and propagation speed of the wave packet. The general formalism is applied to the collisionless trapped-particle mode in tokamak geometry, the current-driven drift mode, and the negative-energy loss-cone mode in a magnetic-mirror geometry. (auth)

311 STABILITY CRITERION OF THE G-MODE IN A TOROIDAL PLASMA. Mikhailovskii, A. B. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 15: No. 1, 95-102(Feb 1975).

A general criterion is obtained for the stability of a toroidal plasma with respect to g-mode perturbations, which were first considered by Furth, Killeen and Rosenbluth for a plasma of finite conductivity in a magnetic field with shear and gravitational field g. The criterion is used to elucidate the stability of g-mode perturbations in an axially symmetric tokamak of circular cross-section. It is shown that, if aq'/q is positive and not too small, g-mode perturbations are stable for $q^2 > 1$ (where q is the safety factor, a is the radius and the prime denotes a derivative with respect to a). With negative values of aq'/q, instability is possible even if $q^2 \gg 1$. (auth)

312 TEMPERATURE-DENSITY STABILITY IN TOKAMAK REACTORS OPERATING ON THE D–T CYCLE. Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Fusion; 15: No. 1, 63-73 (Feb 1975).

The steady-state operating conditions and stability against temperature-density excursions are evaluated for tokamaks operating in the reactor regime on a D-T cycle. Global ion and alpha-particle balances and global ion and electron energy balances, together with MHD equilibrium and stability constraints, constitute the basic computational model. Constant, neoclassical, neoclassical-diffusion and trapped-ion instability scaling for particle and energy confinement times are considered. Steady-state operating conditions tend to be unstable below about 30 keV for constant confinement time scaling, assuming equal particle and energy confinement times. These low-temperature conditions are somewhat more unstable with neoclassical scaling and somewhat less unstable with trapped-ion instability scaling. The unstable modes, at low temperatures, are identified as pure temperature fluctuations for constant and neoclassical diffusion scaling, but as mixed temperature density fluctuations for trapped ion instability scaling. At higher temperatures, the least stable mode is a pure density fluctuation, for all confinement time scaling laws considered. Increasing the particle confinement time relative to the energy confinement time causes a build-up of alpha particles, with attendant bremsstrahlung enhancement, and a reduction in stability against temperature-density excursions. (auth)

313 GENERAL PEELING INSTABILITY. Lortz, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 15: No. 1, 49-54(Feb 1975).

The stability of a general toroidal MHD equilbrium with a continuous pressure profile is investigated for the case where the fluid is surrounded by vacuum. It is found that a disturbance which is localized near the free boundary grows exponentially in time unless a certain necessary criterion is satisfied. Because of the weaker boundary condition, this criterion imposes a more stringent restriction on the configuration than does Mercier's criterion near the boundary. For the cylindrically symmetric case the criterion requires a decrease of the rotational transform and yields a critical relation between the shear and the pressure gradient. (auth)

314 SCATTERING AND MODULATION INSTABILITIES IN MAGNETIZED PLASMAS. Yu, M. Y.; Spatschek, K. H.; Shukla, P. K. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 12, 1736-1741(Dec 1974).

The decay of a high-frequency wave into a scattered and an electrostatic wave is investigated for a homogeneous magnetized plasma. For wave propagation in arbitrary directions, an equation for the scattered wave is obtained accounting for the effect of the nonlinear current density produced by the three-wave interaction process. As an illustration, the propagation of electromagnetic waves perpendicular to the external magnetic field is considered. The growth rates and thresholds for the stimulated scattering and modulational instabilities are obtained. The influence of a weak inhomogeneity is also considered. (auth)

315 DYNAMIC TURBULENCE REGIMES OF PLASMA OSCILLATIONS. Litvak, A.G.; Trakhtengerts, V.Y.; Fedoseeva, T.N.; Fraiman, G.M. (Radiophysics Research Institute). JETP Lett. 20: No. 8, 248-249 (20 Oct 1974).

It is shown analytically and with the aid of computer calculations that stabilization of parametric instability of Langmuir oscillations in strong high–frequency fields can be produced by generating in–phase spatial harmonics of the field of the unstable oscillations. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 1505, 1614, 1639, and 1919.

316 (BNL-19766) REMOVAL OF TRITIUM FROM SOLID CTR BLANKET MATERIALS. Progress Report. Wiswall, R. H.; Wirsing, E. (Brookhaven National Lab., Upton, N. Y. (USA)). 11 Feb 1975. 20p. Dep. NTIS $4.00.

It has been shown experimentally that tritium can be easily removed from certain solid lithium compounds that have been proposed as components of CTR breeder blankets. The compounds tested were LiAl, $LiAlO_2$, and Li_2SiO_3 in granular or powder form; the procedure was to pass a stream of helium through a bed of material maintained at a temperature in the range 400 to 600°C. As the tritium, which had been previously generated in the materials by exposure to thermal neutrons, diffused out and was carried away, its concentration was continuously monitored by radioactive assay of the gas stream. From the data, it was possible to calculate average lifetimes of tritium in a continuously extracted breeder blanket. Lifetimes of a few hours were found for LiAl at 400 to 500°, $LiAlO_2$ at 600° and Li_2SiO_3 at 500 to 600°. (auth)

317 (BNL-19833) PULSED NEGATIVE HYDROGEN SOURCE FOR CURRENTS UP TO ONE AMPERE. Prelec, K.; Sluyters, T. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 4p. (CONF-750335-38). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

During the 2nd Symposium on Ion Sources and Formation of Ion Beams, the development of a Mk II pulsed double slit magnetron source for the production of negative hydrogen ions was discussed. The source was capable of yielding beam currents up to 125 milliamperes, corresponding to current densities of 1.25 A/cm². In order to increase negative hydrogen beam intensities by an order of magnitude (this would be quite useful for initial high energy neutral injector systems on Tokamaks), a larger, Mk III magnetron has been constructed, with the number of slits increased up to six. The idea was to utilize in a more efficient way the plasma width In addition, such a source geometry will be more adaptable for beam formation and acceleration than single slit structures. With three extraction slits, a negative hydrogen yield of 300 mA was obtained with current densities of 1.2 A/cm²; preliminary results with six extraction slits showed beam currents in excess of half an ampere with averaged current densities in excess of 0.75 A/cm². (auth)

318 (BNL-19885) APPLICATIONS OF CONTROLLED THERMONUCLEAR REACTOR (CTR) FUSION POWER IN THE STEEL INDUSTRY. Jordan, R. K.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1975. 54p. Dep. NTIS $5.75.

A review of the process and economics of basic steel production is presented for the purpose of indicating where CTR fusion energy may be applicable. The present conventional air blown blast furnace produces a relatively low Btu value top gas with limited usefulness. The industry consumes relatively large amounts of natural gas for reheating ingots, plates, etc. A concept is presented wherein oxygen is used in the blast furnace which would double the capacity of the furnace and produce a rich carbon monoxide gas stream useful as synthesis gas for methanol and ammonia production. A CTR supplying high energy radiation in a blanket would disproportionate carbon dioxide to carbon monoxide and oxygen which could be used at high temperatures in the blast furnace in place of an oxygen supply stream. Coke would be used in this scheme. In a second scheme the oxygen is separated from the disproportioned CO_2 stream and CO is used in a direct reduction furnace which is followed by an electric furnace to refine the reduced product. Other schemes include iron ore reduction with electrolytic hydrogen and the use of thermal energy for reforming coal with steam or CO_2 for production of reducing gas. The electrosmelting of scrap metal using CTR power could become an important operation in the future. A complex of steel, fertilizer,

fuel and chemical production is presented. Steel capacity and power requirement data are presented and projected to the year 2020. (auth)

319 (BNL-19902) REALITIVISTIC HEAVY IONS FOR FUSION APPLICATIONS. Maschke, A. W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 2p. (CONF-750335-31). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

This is a brief description of what a thermonuclear power generating station might look like in 6 to 10 years from now. The plant consists of four major systems which differ from conventional stations. One is the thermonuclear reaction vessel, designed to absorb the neutron energy released upon ignition of a pellet of fusile material. The second major system is the pellet compressor system. The third consists of the fuel system, i.e., the pellets themselves. The fourth system, the igniting system, will make up the bulk of this paper, because it is primarily this system which involves accelerator technology. The essential ingredient in this design lies in the fact that no substantial extrapolations of existing technology is necessary to build these components. The component systems can all be designed and built today. Nuclear reactors took more than twenty years to get from a demonstration of feasibility to an economically viable source of energy. It is obviously premature, at this stage in the development, to anticipate all of the problems. Nevertheless, systems are reviewed bearing costs in mind. (auth)

320 (BNL-tr-589) DESIGN PARAMETERS OF TOKAMAK-7 SYSTEM. Ivanov, D. P.; Keilin, V. E.; Klimenko, E. Yu.; Strelkov, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). [nd]. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, NY), from a Russian paper. 7p. Dep. NTIS $4.00.

Superconducting windings for the main magnetic field of Tokamak-7 are discussed. The parameters of this facility are based on the use of commercially available superconducting materials for fields up to 80 kOe. Experimental parameters are described. (MOW)

321 (BNL-tr-592) INVESTIGATION OF THE EFFECT OF A PULSED MAGNETIC FIELD ON THE EFFICIENCY OF FORCED-COOLED SUPERCONDUCTING MAGNETS. Agureev, V. N.; Ivanov, D. P.; Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A.; Novikov, I. A.; Stavisskii, B. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1974. Translation by S. J. Amoretty of IAE-55-3. 46p. Dep. NTIS $5.50.

The results of calculations and measurements of the effect of a pulsed field on the superconducting magnets for the Tokamak-7 system are described. The current winding consists of a nine-channel, copper electrolytic bus containing multiple-strand conductors made of Nb-Ti superconducting HT-50 alloy. An analysis is given for the energy dissipation in cylindrical conductors in a longitudinal magnetic field with a square pulse. Shielding against the pulsed field is described. An experimental study was made of the pulse heating of a superconducting bus bar. Also, a model study was made of pulse heating of force-cooled superconducting magnets. (MOW)

322 (COO-1779-155, p 77) ORBIT PROPERTIES OF IONS IN A MIGMA FUSION DEVICE. Gordon, M. M.; Johnson, D. A. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

323 (COO-2218-27) SIMULATION OF A D-T BURN USING D^3He IN TCT. Part I. Superthermal Ion and Fusion Product Pressure Considerations. Petrie, T. W.; Miley, G. H. (Illinois Univ., Urbana (USA)). 1 Mar 1975. Contract AT(11-1)-2218. 21p. Dep. NTIS $4.25.

Helium-3 is substituted for a tritium background in a two component system in order to minimize the neutronics problems. It is found that, under appropriate conditions, helium-3 can be expected to simulate rather well several aspects of injected deuterium and fusion product pressures that are anticipated for the proposed D-T experiments with the TCT. (auth)

324 (COO-2456-9) PHYSICS OF A WALL-CONFINED FUSION SYSTEM. Gross, R. A. (Columbia Univ., New York (USA). Plasma Lab.). Feb 1975. Contract AT(11-1)-2456. 34p. Dep. NTIS $4.75.

To understand plasma phenomena which will occur in a wall-confined, shock-heated fusion system, experiments and computer simulations have been carried out. The thermonuclear fusion cycle, energy transfer from a beta greater than 1 hot plasma to a wall, plasma confinement by means of walls and a magnetic dam, and some new strong shock wave physics results are described and reviewed. (auth)

325 (JUL-1127-RG) METHOD FOR THE DETERMINATION OF THE SPACE-DEPENDENT TRITIUM PRODUCTION RATE IN A FUSION REACTOR BLANKET MODEL WITH THE AID OF SOLID-STATE-TRACK DETECTORS. Geiser, H.; Cloth, P.; Filges, D.; Herzing, R.; Kirch, N. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Oct 1974. 68p. (In German). Dep. NTIS (US Sales Only) $6.50.

An experimental method for measuring the relative, space-dependent tritium production in a blanket model of lithium metal was developed. This method is based upon the registering of tracks of ionizing particles in solids. The special problems connected therewith are discussed. Measurements of the tritium "breeding-rate" distribution were performed and compared with results of transport- and Monte Carlo calculations. Near the neutron source, considerable deviations result. Independent measurements of the fast neutron flux distribution show deviations with the same tendency. So it must be supposed that the calculations are not correct. (auth)

326 (LGI.R/TOR.TEC-74.1/E) FLEXIBLE TOROIDAL MACHINE OF THE TOKAMAK TYPE. Bosia, G.; Knoepfel, H.; (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Gas Ionizzati). Jan 1974. 43p. Dep. NTIS (US Sales Only) $5.25.

Magnet systems are described for tokamak-type machines. The main requirements for the study were: (1) medium sized tokamak with aspect ratio <3.5, toroidal field ~40 kG, (2) flexible electromechanical design, allowing good and relatively easy access for modifications and repairs, (3) good access for diagnostic systems and additional heating methods, and (4) flux capability of the transformer of ~2 Weber for driving plasma currents of up to 600 kA. Different magnet systems are described. (MOW)

327 (ORNL-TM-4884) IMPURITY STUDY EXPERIMENT PROPOSAL. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 100p. Dep. NTIS $8.00.

ISX is a modest tokamak which emphasizes the production of a predictable test plasma, experimental flexibility, ease of assembly and disassembly, and good diagnostic access. Its plasma models the outer cooler layers in EPR like plasmas. In addition, provisions will be made for long discharge times which may be necessary to observe some impurity effects. These machine characteristics will enable one to study the collisional transport of impurities in the plasma, perform systematic studies of wall and limiter materials and geometries, study methods of cleaning the walls, and develop and test new diagnostic techniques. ISX will employ water-cooled copper coils to produce a maximum toroidal magnetic field of 20 kG at the plasma axis, which is 77 cm from the major axis. The plasma minor radius will be about 15 cm, and the maximum plasma current will be 100 kA which will be induced by an iron core transformer with a capability of up to 0.9 volt-sec for long discharges. An aspect ratio of five and the modest magnetic field permit a design with ample space for thick wall structures such as honeycomb walls. The "picture frame" toroidal field coil provides additional space, while removable coil top sections allow easy replacement of the vacuum chamber. The 72-turn toroidal field coil is grouped into 24 sections for increased access. Absence of a conducting shell and placement of the vertical field and transformer primary coils away from the plasma allow easy viewing of the plasma and good diagnostic access. (auth)

328 (SAND-74-0439) LASER-FUSION AND ELECTRON-BEAM-FUSION RESEARCH PROGRESS REPORT, JANUARY-JUNE 1974. Beckner, E. H.; Gerardo, J. B.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 114p. Dep. NTIS $4.00.

Highlights of this reporting period are: (1) Sandia four-beam laser was completed, and an extensive series of pellet implosions were conducted. The targets were CD_2, LiD, and CDT spheres ranging in size from 50 to 500 microns in diameter. (2) New techniques were developed to measure directly the electric fields associated with laser-produced plasma and also for picosecond x-ray measurements. (3) Numerous experiments on HF chemical lasers are reported. (4) Extensive investigations were continued on the xenon and iodine laser systems. (5) In the electron beam program, the major effort is to develop short pulse REB accelerators which can be used in pellet implosion experiments. (6) Experimental and theoretical diagnostic work is also described. (MOW)

329 (SAND-74-5589) HARP, A SHORT PULSE, HIGH CURRENT ELECTRON BEAM ACCELERATOR. Prestwich, K. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 17p. (CONF-750335-39). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

A 3 MV, 800 kA, 24 ns electron beam accelerator is described and the results of initial switching experiments are discussed.

The generator will provide a source for studying the physics of processes leading to electron beam driven, inertially confined fusion. The major components of the accelerator are two diodes with a common anode, twelve oil-dielectric Blumleins with low jitter (less than 2 ns) multichannel switches, three intermediate storage capacitors, a trigger pulse generator and two Marx generators. (auth)

330 (UCID-16715) PROPAGATION STUDIES WITH CHOPPED BEAMS. Lauer, E. J.; Lamb, W. A.; Hester, R. E.; Spoerlein, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1975. Contract W-7405-Eng-48. 30p. Dep. NTIS $4.50.

An experimental study of chopped electron-beam propagation is described. Earlier studies of hose instability suppression by modulation ("partial chopping") of the beam current had given encouraging results. In the present studies, a technique for achieving fully chopped beams was developed, and experiments on propagation over distances up to 18 m were carried out. The experimental evidence indicates significant stabilization, in spite of the rather strong transverse perturbations that are introduced by the chopping procedure. (auth)

331 (UCID-16754) DT FUSION NEUTRON IRRADIATION OF LASL–BNL SUPERCONDUCTOR WIRES, LLL COPPER TENSILE SPECIMENS, ORNL MAGNESIUM OXIDE CRYSTAL, UW–LLL HIGH PURITY METALLIC FOILS, AND SLL FIBER OPTICAL BUNDLES. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Mar 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

The LLL Rotating Target Neutron Source was used to irradiate samples of several CTR materials. Some of the experiment specifics are described, however, no results are given. (MOW)

332 (UCRL-76712) RECENT PROGRESS IN ION SOURCES. Osher, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Mar 1975. 8p. (CONF-750335-35). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

This paper is intended to survey recent developments in ion sources, particularly work reported at the "Symposium on Ion Sources and the Formation of Ion Beams" held in Berkeley in October 1974. The approach here will be to subdivide this topic into three main areas; briefly list and discuss notable progress in each; and finally add some additional detail through a few specific, selected examples. The major items of progress discussed include development of large-area plasma surfaces for multiple-aperture ion sources, a significant increase in available negative-ion current densities, and improved general agreement between extraction electrode design and performance. (auth)

333 FUSION REACTOR: PHYSICAL AND TECHNICAL PROBLEMS. Wienecke, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 123-147 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German)

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

The physical principles of nuclear fusion are summarized, and the properties of a plasma are given. Fusion devices with magnetic confinement are described. These include magnetic mirrors, tokamaks and stellerators, and high-β devices. Inertial confinement is also discussed. The technology of fusion reactors is outlined. The advantages of fusion reactors are outlined and their future development is briefly considered. (JSR)

334 THERMONUCLEAR FUSION. Hsing, C. C. (Tsing Hua Univ., Peking). Wu-li; 3: No. 3, 153-158(18 Jun 1974).

In the past few years considerable progress has been made toward achieving a practical fusion-power reactor. This article presents a brief overview of the current status of fusion reactor design. Representative classes of fusion reactors are: (1) tokamak-type machines, (2) magnetic mirror type machines, (3) theta pinch machines, and (4) laser fusion machines. The tokamak class of plasma containers, a toroidal plasma-confinement machine used in fusion research, is discussed in detail. The principal components and the fundamental requirements of the tokamak-type machines are presented. Laser fusion, a very-high-density, fast-pulsed system in which a pellet of fuel is ionized instantaneously by a pulse from a high-power laser, producing an inertially confined plasma, is then discussed. The other two types are mentioned briefly. (JPRS)

335 FISSION–FUSION SYSTEMS: HYBRID, SYMBIOTIC, AND AUGEAN. Lidsky, L. M. (Massachusetts Inst. of Technology, Cambridge). Nucl. Fusion; 15: No. 1, 151-173(Feb 1975).

The achievement of controlled fusion will make available excess neutrons which can be used in various ways in combined fission-fusion power cycles. The various schemes are here classified as hybrid—in which heavy-element fission occurs in the fusion blanket; symbiotic—in which fissile material is bred in the absence of fission events; and augean—in which the neutron surplus is used to transmute fission reactor waste products. The earliest work in this field, unpublished and originally classified secret, is reviewed. Recent studies of hybrid systems based on subcritical thermal and subcritical fast-fission blankets are described in detail. An analysis of symbiosis based on the Th-U fuel cycle is summarized. The conditions required for high-level waste transmutation are presented; Augean systems seem best suited to actinide waste burning. It is concluded that basic physics of various fission-fusion systems has been surveyed but the engineering and economic aspects of combined systems have been largely ignored. It remains to be shown whether fission-fusion systems will prove superior to alternative methods of accomplishing the same ends. (auth)

336 POWER BALANCE AND STRESS PROBLEMS OF INTERNAL-CONDUCTOR SYSTEMS. Lehnert, B. (Royal Inst. of Technology, Stockholm). Nucl. Fusion; 15: No. 1, 39-47(Feb 1975).

A number of technological problems concerning the coils in internal conductor systems is investigated, with an efficient plasma confinement imposed as a working hypothesis: (1) At technically feasible power levels and linear dimensions, the Ohmic power losses can, under optimized conditions, be made much smaller than the thermonuclear reaction power, even with ordinary metal windings at temperatures of some hundred degrees centigrade. Thus, superconducting coils should not become necessary in these systems. (2) The mechanical stresses can be kept well below the limits of tensile strength of possible coil materials. In addition, both the internal coils and their magnetically shielded supports can be made magnetically force-free in certain cases. (3) These results are due to the fact that high beta values are, in principle, available in systems with a main poloidal field, and that only a fraction of the total magnetic field energy originates from the internal conductors. This provides an important advantage over systems with a main toroidal field where, at a given plasma pressure, the Ohmic power losses and mechanical stresses become between one and two orders larger than those of poloidal field systems. (4) The coil supports can be made large enough to provide cooling ducts for the internal conductor system. (auth)

337 DISTRIBUTION FUNCTION FOR NUCLEAR FUSION REACTION PRODUCTS IN A STATIONARY THERMONUCLEAR REACTOR. Kolesnichenko, Ya. I. (Nuclear Research Inst., Kiev). Nucl. Fusion; 15: No. 1, 35-37(Feb 1975).

The shape of the distribution function for the products of a thermonuclear reaction (α particles) that is brought about through Coulomb scattering of α particles by plasma electrons and ions. It is assumed that the thermonuclear reaction is stationary and that the energy of the reaction products is transmitted to the plasma. Consideration of the problem is based on a kinetic equation for the α-particle distribution function, in which the Coulomb collisions are taken into account by means of the Landau collision term. (auth)

338 NEUTRON DIAGNOSTICS FOR PULSED PLASMA SOURCES. Young, F. C. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 718-723(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Neutron detectors have been developed and applied to a variety of pulsed plasma sources with intensities ranging from 10^2 to 10^{12} neutrons/pulse. For yields as small as 10^2 neutrons, a ^{6}Li-glass-scintillator detector is used. A rhodium-activation counter has been developed for yields greater than 10^6 neutrons. These detectors are used for total yield and angular distribution measurements. Neutron energies are determined primarily by the time-of-flight technique. Limitations on this technique for neutron yield and energy measurements are discussed. Improved methods are needed to measure the spatial extent of these neutron sources. (auth)

339 CONTROLLED NUCLEAR FUSION AND ITS POTENTIAL CONTRIBUTION TO FUTURE ENERGY NEEDS. Braams, C. M. Trans. Amer. Nucl. Soc.; 20: 779-780(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

340 SYSTEMS STUDIES OF PROPOSED FUSION REACTORS. Hancox, R. Trans. Amer. Nucl. Soc.; 20: 780-781 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

341 POTENTIAL OF LASER COMPRESSION AS THE BASIS OF A FUSION REACTOR. Brueckner, K. A. (Univ. of California, San Diego). Trans. Amer. Nucl. Soc.; 20: 781-783 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

342 POTENTIAL OF MAGNETIC CONFINEMENT AS THE BASIS OF A FUSION REACTOR. Pease, R. S.; Schluter, A. Trans. Amer. Nucl. Soc.; 20: 783-785(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

343 RECENT PROGRESS OF TOKAMAK EXPERIMENTS. Prevot, F. Trans. Amer. Nucl. Soc.; 20: 786(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

344 PROGRESS IN ASSESSING THE TECHNOLOGICAL PROBLEMS OF FUSION REACTORS. Darvas, J. (Kernforschungsanlage, Juelich, Ger.). Trans. Amer. Nucl. Soc.; 20: 786-787(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

345 ON THE POSSIBILITY OF A MHD CONVERSION OF ENERGY FROM THERMONUCLEAR REACTORS. Velichov, E. P.; Golubev, V. S.; Cernucha, V. V. Arch. Energiewirt.; 28: No. 24, 1211-1215(Dec 1974). (In German).
2 figs.; 4 refs. Also published in At. Ehnerg. (Apr 1974) v. 36(4) p. 258-260.
The possibility of using the conduction and induction switches of MHD generators to convert thermonuclear energy of pulsed fusion reactors into electrical energy for the power plant building with power of about 10 GW is discussed. (AH/LA)

346 ENHANCEMENT IN THERMONUCLEAR REACTION RATES IN A DENSE PLASMA. Lee, H. J. (Notre Dame Univ., IN). Nature (London); 253: No. 5489, 259-260(24 Jan 1975).
For laser-driven fusion a number density of the order 10^{26} cm^{-3} is usually envisaged; here the effects of the presence of a medium on the nuclear reaction rates are considered and the feasibility of enhanced fusion rates when a certain condition is met is shown. The results are applicable both to controlled thermonuclear reactions and to astrophysical conditions. (auth)

347 FUSION REACTOR SYSTEMS. Ribe, F.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Rev. Mod. Phys. 47: No. 1, 7-41 (Jan 1975).
In this review we consider deuterium-tritium (D-T) fusion reactors based on four different plasma-confinement and heating approaches: the tokamak, the theta-pinch, the magnetic-mirror, and the laser-pellet system. We begin with a discussion of the dynamics of reacting plasmas and basic considerations of reactor power balance. The essential plasma physical aspects of each system are summarized, and the main characteristics of the corresponding conceptual power plants are described. In tokamak reactors the plasma densities are about 10^{20} m^{-3}, and the β values (ratio of plasma pressure to confining magnetic pressure) are approximately 5%. Plasma burning times are of the order of 100-1000 sec. Large superconducting dc magnets furnish the toroidal magnetic field, and 2-m thick blankets and shields prevent heat deposition in the superconductor. Radially diffusing plasma is diverted away from the first wall by means of null singularities in the poloidal (or transverse) component of the confining magnetic field. The toroidal theta-pinch reactor has a much smaller minor diameter and a much larger major diameter, and operates on a 10-sec cycle with 0.1-sec burning pulses. It utilizes shock heating from high-voltage sources and adiabatic-compression heating powered by low-voltage, pulsed cryogenic magnetic or inertial energy stores, outside the reactor core. The plasma has a density of about 10^{22} m^{-3} and β values of nearly unity. In the power balance of the reactor, direct-conversion energy obtained by expansion of the burning high-β plasma against the containing magnetic field is an important factor. No divertor is necessary since neutral-gas flow cools and replaces the "spent" plasma between pulses. The open-ended mirror reactor uses both thermal conversion of neutron energy and direct conversion of end-loss plasma energy to dc electrical power. A fraction of this direct-convertor power is then fed back to the ion-injection system to sustain the reaction and maintain the plasma. The average ion energy is 600 keV, plasma diameter 6 m, and the plasma beta 85%. The power levels of the three magnetic-confinement devices are in the 500-2000 MWe range, with the exception of the mirror reactor, for which the output is approximately 200 MWe. In Laser-Pellet reactors, frozen D-T pellets are ignited in a cavity which absorbs the electromagnetic, charged particle, and neutron energy from the fusion reaction. The confinement is "inertial," since the fusion reaction occurs during the disassembly of the heated pellet. A pellet-cavity unit would produce about 200 MWt in pulses with a repetition rate of the order of 10 sec^{-1}. Such units could be clustered to give power plants with outputs in the range of 1000 MWe. (auth)

348 PLASMA-SOLID INTERACTION IN A THETA PINCH. Nunnally, W.C.; Kristiansen, M.; Hagler, M.O. (Plasma Laboratory, Department of Electrical Engineering, Texas Tech University, Lubbock, Texas 79409). Appl. Phys. Lett. 26: No. 9, 496-499 (1 May 1975).
The interaction of a dense high-temperature theta pinch plasma with 0.2-mm-diam spherical polystyrene pellets is reported. The pellets are not displaced by the plasma sheath implosion. They are not completely vaporized and the vaporized material is not ionized after many half-cycles of theta pinch action. The vaporized material remains neutral in the midst of the hot plasma for the duration of the experiment. The cloud ionization is increased by focusing a 1-J Q-switched ruby laser on the cloud after the initial plasma vaporization. (auth)

Wave Phenomena

349 (AD-785404) STUDY OF FIELD–PLASMA INTERACTION BY TRANSIENT TECHNIQUES. Final Report. Cheo, B. R.; Kunhardt, E. E. (New York Univ., Bronx, N. Y. (USA). Dept. of Engineering and Science). Aug 1974. 86p. (AFOSR-TR-74-1373). NTIS $4.00.
Field-plasma interactions were investigated in two areas: the parametric excitation of ion-acoustic waves and the propagation of kV/cm sub-nanosecond electric field pulses (impulses) along a plasma column. In the investigations of parametric excitation of ion acoustic waves, the authors center around both the above and below threshold conditions. The study of impulse propagation was studied using a high amplitude (about 2 kV/cm) fast (about 200 ps) pulse generator called bouncing ball generator (BBG). The observations were made with the aid of a sampling scope. The launching structure excites mostly a transient surface wave packet whose behavior was analyzed in detail theoretically. (auth)

350 (COO-3004-10) DRIFT WAVES IN A NONUNIFORM PLASMA. Research Report. Sanuki, H.; Schmidt, G. (Stevens Inst. of Tech., Hoboken, N. J. (USA). Dept. of Physics). Feb 1975. Contract AT(11-1)-3004. 20p. Dep. NTIS $4.00.
An eigenvalue equation describing the propagation of collisionless electrostatic drift waves in a magnetoplasma, with an arbitrary one dimensional density profile is derived. It is shown that in general several different waveforms exist each with its respective dispersion relation. A special density profile was analyzed in detail. (auth)

351 (IPP-6/129) STIMULATED RAMAN SCATTERING FROM PLASMAS IRRADIATED BY NORMALLY AND OBLIQUELY INCIDENT LASER LIGHT. Biskamp, D.; Welter, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Oct 1974. 8p. INIS.
The frequency spectrum and the angular distribution of the scattered light, and the absorption coefficient due to stimulated Raman scattering are obtained by extensive numerical simulations of one- and two-dimensional plane plasma targets irradiated normally or obliquely by high-power laser light. Theoretical models are given to explain the numerical results. (auth)

352 (NP-20369) APPLICATION OF THE REDUCTIVE PERTURBATION METHOD TO LONG HYDROMAGNETIC WAVES PARALLEL TO THE MAGNETIC FIELD IN A COLD PLASMA. Report No. 48. Mjoelhus, E. (Bergen Univ. (Norway). Dept. of Applied Mathematics). May 1974. 39p. Dep. NTIS (US Sales Only) $5.00.
A nonlinear dispersive equation for the evolution of long waves parallel to the magnetic field in a cold plasma is derived by the reductive perturbation method. The equation predicts that the ion cyclotron mode is stabilized for sufficiently long waves. Special solutions in the form of solitary modulational envelope profiles are found. (auth)

353 (ORNL-TM-4766) SPECTRUM OF A LINEAR ANTENNA IN A COLD MAGNETIZED PLASMA. Eldridge, O.; Kritz, A. H. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 30p. Dep. NTIS $4.50.
The fields radiated by a linear antenna in a cold magnetized plasma are calculated. The principal results are expressed in the input impedance and power spectrum of the near field, expressed as a function of the wavenumber or index of refraction parallel to the field. For frequencies below the electron plasma frequency and above the lower hybrid frequency the spectrum shows a broad maximum for short parallel wavelengths. The parallel index of refraction at this maximum is approximately the ratio of free space wavelength to antenna length. A spectrum of this sort is required by the accessibility conditions for heating at the lower hybrid resonance from a wave launched in a region of lower density. The impedance of a short antenna in this region is capacitive and a few hundred ohms in magnitude. (auth)

354 LINEAR KINETIC EQUATION FOR THE EIGENMODES OF THE BREIT–DARWIN PLASMA. Atamaniuk, B. (Inst. of Fundamental Engineering Researches, Warsaw); Turski, L. A. Collect. Phenomena; 1: No. 3, 131-139(Jan 1974).

A simple linear kinetic equation of the Vlasov type is proposed which determines the eigenmodes of the system of classical particles interacting via the velocity dependent forces, for example, Breit–Darwin plasma. The Zwanzig variational principle is used and the set of decoupled kinetic equations for longitudinal and transverse waves is derived. The longitudinal waves are the usual plasma waves. The frequencies of the transverse waves are determined from slightly modified plasma waves dispersion relation. (auth)

355 ELECTRON BEAM EXCITATION OF LOW FREQUENCY OSCILLATIONS IN A PLASMA BY APPLICATION OF EXTERNAL PERTURBATIONS. Kornilov, E. A.; Kovpik, O. F. (Ukrainian Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 68: No. 2, 530-535(Feb 1975). (In Russian).

Excitation of oscillations is investigated in a plasma–beam discharge (density 10^{11} to 10^{13} electrons/cm^3) located in the magnetic field of a mirror trap modulated by the electron beam (energy 30 kV, current 10 A) at the frequency of the lower hybrid resonance. It is shown that by means of external modulation slow waves can be effectively excited in volumes which considerably exceed the beam volume. Excitation of oscillations is due to nonlinear interaction between high frequency Langmuir and the low frequency waves. (auth)

356 NONSTATIONARY SELF-FOCUSING OF A GAUSSIAN PULSE IN A PLASMA. Sodha, M. S.; Prasad, S.; Tripathi, V. K. (Indian Inst. of Tech., New Delhi). J. Appl. Phys.; 46: No. 2, 637-642(Feb 1975).

The self-focusing of a cylindrically symmetric Gaussian (in space and time) electromagnetic pulse in collisionless and collisional plasmas has been studied by considering the ponderomotive force and the nonuniform heating (and consequent redistribution of electrons) as the sources of nonlinearity. The duration of the pulse is considered larger than the characteristic time of nonlinearity; the WKB and paraxial ray approximations have been used to solve the wave equation. It is found that the beam is focused in a moving filament. Because of relaxation effects the peak of the pulse is shifted to higher values of t - z/nu/sub g/ (in the case of collisionless plasmas) and the pulse is severely distorted because of self-focusing: the shift of peak in the case of collisionless plasmas is not significant. (auth)

357 INTERACTION OF PLANE LANGMUIR SOLITONS. Abdulloev, Kh. O.; Bogolyubskii, I. L.; Makhan'kov, V. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Nucl. Fusion; 15: No. 1, 21-26(Feb 1975).

The formation and interaction of Langmuir solitons is governed by the Schroedinger equation with a self-consistent potential. Generally, two kinds of interaction—quasi-static and dynamic—are considered. In the former case, the problem reduces to solving the Schroedinger equation with a cubic term, while in the latter, the self-consistent potential satisfies the wave equation. It is maintained that in the quasi-static description, solitons do not asymptotically interact with each other if uninteresting shifts of the soliton phases are disregarded. In the dynamic approach—which is physically more consistent—solitons may interact with each other and with acoustic waves. The article considers the problem of the interaction of two identical solitons moving toward each other. Semi-quantitative estimates have been used in order to determine the region of parameters in which fusion of solitons is possible. The numerical modelling results which refine the analytical estimates are discussed. The analysis shows that there is practically no region where the quasi-static approximation can be applied, since this approximation disregards the low-frequency motions which are fundamentally important for the process of Langmuir turbulence instability. The process of soliton formation from a non-symmetrical Langmuir-wave packet is investigated. A study is made of the influence of the boundary conditions, especially the periodic ones, on the formation and interaction of solitons. Applying numerical modelling, the authors show that great caution must be exercised in using the periodic boundary conditions for unbounded systems. Wave boundary conditions were suggested. (auth)

358 PLASMA WAVES IN AN INHOMOGENEOUS PLASMA CARRYING A CURRENT. Bhatnagar, T. N.; Sharma, S. R. (Univ. of Rajasthan, Jaipur, India). Can. J. Phys.; 53: No. 4, 385-390(15 Feb 1975).

Wave propagation in a magnetoactive plasma carrying a constant current is considered for the case of uniform and nonuniform media having a weak density gradient. The effect of drift velocity and nonuniformity is examined in detail for the longitudinal electrokinetic wave and the low frequency helicon wave propagation. (auth)

359 NONLINEAR WAVE NUMBER OF AN ELECTRON PLASMA WAVE. Vidmar, P.J.; Malmberg, J.H.; Starke, C.P. (Department of Physics, University of California at San Diego, La Jolla, California 92037). Phys. Rev. Lett. 34: No. 11, 646-649 (17 Mar 1975).

The wave number of an electron plasma wave propagating on a collisionless plasma column is found to differ from that of a small-amplitude wave at the same frequency. The nonlinear wave-number shift oscillates in space. The magnitude of its first maximum, when normalized to the initial (nonlinear) damping coefficient, is found to be proportional to the square root of the initial wave amplitude. (auth)

360 STABILITY OF ENVELOPE SOLITONS. Schmidt, G. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Rev. Lett. 34: No. 12, 724-726 (24 Mar 1975).

One-dimensional envelope solitons are unstable against modulation in the direction perpendicular to their propagation for all amplitudes and wave numbers. This is a special case of the filamentation instability. (auth)

ENGINEERING

Energy Conversion

361 (AI-AEC-12934) ADVANCED DIRECT-RADIATING THERMOELECTRIC PROGRAM. Final Report. Johnson, J. L.; Garvey, L. P. (Atomics International Div., Canoga Park, Calif. (USA)). 30 May 1970. Contract AI(04-3)-701. 128p. Dep. NTIS $9.50.

Declassified 6 Sep 1973.

The Advanced Thermoelectric Program was directed toward the development and testing of a direct-radiating thermoelectric module capable of operating for a period of five years at 1300°F with a liquid-metal-cooled system. This is the final progress report and covers the period from January 1969 through January 1970. Program activities during this period were concentrated on testing and evaluating the eight-couple silicon-germanium thermoelectric module using both electrical and NaK heating, and on a systematic termination of the program. The development of bonding systems and fabrication techniques as well as the fabrication of all modules was completed previously. This program has resulted in the development of an eight-couple module having an endurance life of four to five years at 1300°F liquid-metal (NaK-78) temperature. The module has demonstrated the ability to withstand thermal cycling and cold- or hot-shock vibration loads. Module life tests at 1338, 1371, 1423, 1477, and 1530°F equivalent NaK temperatures accumulated 20,827, 20,877, 16,534, 7,507, and 2,190 hours respectively. Ten modules in a NaK loop accumulated 8,740 hr. Post-test examination was made of 13 additional reference design modules tested at these conditions. (auth)

362 (COO-2155-14) BIOMEDICAL ENGINEERING SUPPORT. First Quarterly Report for August 16–November 15, 1974. Kolff, W. J.; Smith, L. M.; Sandquist, G. M. (Utah Univ., Salt Lake City (USA). Inst. for Biomedical Engineering). 1974. Contract AT(11-1)-2155. 32p. Dep. NTIS $4.75.

Results are reported from preliminary tests of the performance of a ^{238}Pu-powered artificial heart. Data are reported on the effects of implantation of an electric motor on the survival of two calves. (CH)

363 (GA-6818) RADIOISOTOPE SPACE POWER GENERATOR. Annual Summary Report for the Period October 1, 1964–September 30, 1965. Baker, F.; Elsner, N.; Godsin, W.; Leedy, R.; Pidd, R.; Ream, J. (General Atomic Co., San Diego, Calif. (USA)). 27 May 1966. Contract AT(04-3)-167. 100p. Dep. NTIS $8.00.

Declassified 5 Sep 1973.

Progress during the period from Oct. 1964 to Oct. 1965 in the development of radioisotope-fueled thermoelectric generators for space power systems is reported. Information is included on thermocouple fabrication and testing; generator design and fabrication; and life and performance testing of two modules. (LCL)

364 (GA-8928(Pt.1)) THERMOELECTRIC GENERATORS FOR SPACE MISSIONS. Annual Summary Report for the Period July 1, 1967–June 30, 1968. Elsner, N. B.; Steeger, E. J.; Emken, M. R.; Leedy, R. L.; Girard, E. H.; Brislin, R. J.; Bradshaw, G. B. (General Atomic Co., San Diego, Calif. (USA)). 4 Nov 1969. Contract AT(29-2)-2564. 115p. Dep. NTIS $8.75.

Declassified 5 Sep 1973.

Bonding of n type PbTe to Ni end caps was found to be principally dependent upon the trace impurities in the Ni and accelerated testing was performed on specimens bonded with different batches of Ni. Bonded elements incorporating a mesh at the hot side bond were investigated and data generated to date indicates mesh bonds will probably exhibit long life-times. Small GeSi elements were fabricated into a lightweight high temperature structure and operated at a T_h of 750°C. This GeSi type structure represents the general concept for cascading with the lower temperature PbTe stage. (auth)

365 (GA-9501) PRELIMINARY ANALYSIS AND EXPERIMENTAL INVESTIGATIONS OF THE TRANSIT/ISOTEC THERMOELECTRIC GENERATOR THERMAL RESPONSE DURING LAUNCH EVENTS. Bradshaw, G. B. (General Atomic Co., San Diego, Calif. (USA)). Jan 1969. Contract AT(29-2)-2564. 77p. Dep. NTIS $7.00.

Declassified 6 Sep 1973.

The TRANSIT/ISOTEC radioisotope thermoelectric power supply will be exposed to ambient environments during launch events. Under the TRANSIT/ISOTEC RTG Program, preliminary analytical and experimental investigations have been performed to assess thermal and electric operating characteristics of the ISOTEC system in different ground support environments. Preliminary computations were also performed on the transient thermal response of the generator during the first 120 seconds of flight, while the power supply and satellite are surrounded by the vehicle heat shield. The results of these analyses are summarized and the launch operations are discussed. Finally, the electrical characteristics of the converter during ground operation are predicted. (LCL)

366 (GA-9502) THERMAL PERFORMANCE OF THE TRANSIT/ISOTEC THERMOELECTRIC GENERATOR IN THE ORBITAL SPACE ENVIRONMENT. Willcutt, G. J. E. Jr.; Bradshaw, G. B. (Gulf General Atomic Co., San Diego, Calif. (USA)). Jun 1969. Contract AT(29-2)-2564. 52p. Dep. NTIS $5.75.

Declassified 6 Sep 1973.

Results of detailed thermal analysis on the TRANSIT/ISOTEC radioisotope thermoelectric power supply in both the laboratory and space orbital environments are presented. Various space cases were considered, allowing a complete description of the thermal performance of the converter under different operational conditions. Specifically, the analysis investigated the thermal effects of satellite coupling, external radiant heat flux distribution, and changes in radiator properties. (auth)

367 (GA-9504) OPERATIONAL CHANGES OF THE ISOTEC GENERATOR PERFORMANCE WITH TIME. Steeger, E. J. (Gulf General Atomic Co., San Diego, Calif. (USA)). Jun 1969. Contact AT(29-2)-2564. 31p. Dep. NTIS $4.75.

Declassified 6 Sep 1973.

During the 5 year operation of the ISOTEC/TRANSIT generator, thermal, thermoelectric and physical changes occur within the system. The generator design through the electrical network design of the thermoelectric couples and the thermal reradiation and distribution within the generator minimize the effects of extended operation. The following conclusions are drawn from the thermal and thermoelectric analysis of time-dependent changes: thermal decay of the ^{238}Pu fuel lowers the hot junction temperature by 12°C in 5 years of operation; a large number of failures of thermoelectric couples can be accommodated in the thermocouple network without increasing the hot junction temperature above 400°C, hence, without affecting the reliability of the thermoelectric couples of the generator; an element failure in the parallel circuit lowers the hot junction temperatures of the adjacent couples, thereby increasing the reliability of the couples that are carrying the larger electrical current; and random element failures are not propagated to other elements in the thermocouple network. (auth)

368 (GA-9506) ISOTEC/TRANSIT THERMOELECTRIC GENERATOR DESIGN SUMMARY. Cruver, J. E.; Perry, L. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). Jun 1969. Contract AT(29-2)-2564. 33p. Dep. NTIS $4.75.

Declassified 6 Sep 1973.

The design features of the ISOTEC/TRANSIT generators are summarized. Two designs are discussed. The first design, which has been used as the reference design for the development program, will deliver 20 W output at the end of five years (EOL). The second design, 30 W EOL, uses the same basic modular units as the lower power level design. Details of tests or analyses are given in other reports. (auth)

369 (GA-9515(Pt.1)) THERMOELECTRIC GENERATORS FOR SPACE MISSIONS. Annual Summary Report for the Period July 1, 1968–June 30, 1969. Elsner, N. B.; Steeger, E. J.; Emken, M. R.; Leedy, R. L.; Girard, E. H.; Brislin, R. J.; Bradshaw, G. B. (Gulf General Atomic Co., San Diego, Calif. (USA)). 10 Jul 1970. Contract AT(29-2)-2564. 187p. Dep. NTIS $12.50.

Declassified 6 Sep 1973.

Progress during the period from July 1968 to July 1969 on the development of TRANSIT thermoelectric generator is reported. As the result of thermal, electrical and mechanical analyses and tests, the mechanically and metallurgically bonded n-element was adopted for use. The p-element work was less extensive. (LCL)

370 (GA-11005) ANNUAL SUMMARY REPORT FOR THE PERIOD JULY 1, 1969–JUNE 30, 1970. Elsner, N.; Steeger, E.; Emken, M.; Leedy, R.; Girard, E.; Bradshaw, G. (Gulf General Atomic Co., San Diego, Calif. (USA)). 22 Sep 1972. Contract AT(29-2)-2564. 105p. Dep. NTIS $8.25.

Declassified 6 Sep 1973.

Both PbTe and PbSnMnTe were fabricated with mesh type hot side bonds and processes were developed to accomplish the

powder metallurgy fabrication by vacuum warm pressing techniques. TAGS $(AgSbTe_2)_{.15}(GeTe)_{.85}$ was investigated with respect to its vaporization characteristics and was found to differ markedly from PbTe type alloys. Techniques were developed for fabricating small SiGe elements and also new methods for attaching end caps to these elements. (auth)

371 (MND-2952-70-2) SNAP 11 PROGRAM. Final Summary Report, February 1962–January 1967. (Martin Marietta Corp., Baltimore, Md. (USA)). May 1967. Contract AT(30-1)-2952. 319p. Dep. NTIS $19.00.

Declassified 4 Sep 1973.

A detailed summary is presented of the technical effort performed to develop a radioisotope thermoelectric generator using a short half-life fuel. The work was accomplished during the period from Feb. 1962 through Jan. 1967. The details of the design analysis and testing of the various generator systems and components are presented. (LCL)

372 (MND-3169-18B) SNAP 19-C2 SITE HAZARDS ANALYSIS AND SAFETY REPORT. (Martin Marietta Corp., Baltimore, Md. (USA)). Jun 1966. 45p. Dep. NTIS $5.25.

Declassified 28 Nov 1973.

The final safety evaluation of a SNAP 19-C2 thermoelectric power system on a terrestrial mission is presented. It is concluded that the SNAP 19C-2 generator will operate safely under all normal conditions and credible abnormal conditions while at the installation site. As with any nuclear device, precautions should be taken when handling and transporting the system. (auth)

373 (MND-3393-3) ADVANCED ^{90}Sr SPACE POWER SUPPLY. 250 Watt Dynamic System. (Martin Marietta Corp., Baltimore, Md.(USA)). [nd]. 8p. Dep. NTIS $4.00.

Declassified 6 Sep 1973.

The design and predicted performance of a ^{90}Sr-fueled spacecraft thermoelectric system which uses the spacecraft skin as a large, low-temperature radiator are described. (LCL)

374 (MND-3393-4) ADVANCED ^{90}Sr SPACE POWER SUPPLY. 250 Watt Static System. (Martin Marietta Corp., Baltimore, Md. (USA)). [nd]. 8p. Dep. NTIS $4.00.

Declassified 6 Sep 1973.

The design and predicted performance of a ^{90}Sr-fueled spacecraft thermoelectric system which rejects its waste heat to space by means of a static fin configuration are described. (LCL)

375 (NYO-3582-12) COMPACT THERMOELECTRIC PROGRAM. Final Phase I Report. Period Covered, June 28, 1965–December 31, 1965. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). 1965. Contract AT(30-1)-3582. 216p. Dep. NTIS $14.00.

Declassified 31 Aug 1973.

Progress during the period from June 28 to Dec. 31, 1965 in the development of a compact thermoelectric generator is reported. Information is included on: reference design module; performance testing and performance; unit assembly; stress analysis of components; reliability; and optimization of converter system. (LCL)

376 (PB-237621) VAPOR CYCLE ENERGY SYSTEM FOR IMPLANTABLE CIRCULATORY ASSIST DEVICES. Annual Report, June 1972–June 1973. Hagen, K. G.; Huffman, F. N. (Thermo Electron Corp., Waltham, Mass. (USA)). Aug 1973. Contract PH-43-68-1455. 362p. (TE-4100-25-74; PH-43-68-1455-5). NTIS $10.00.

The function of the implantable ^{238}Pu-fueled heart assist system is to assume a large fraction of the work of the natural heart by removing the entire cardiac output of the left ventricle at low pressure and boosting it in pressure so that it can perfuse the systemic system. The power to drive the blood pump is obtained by converting a fraction of the nuclear heat into mechanical energy via a novel miniature vapor cycle engine. This report describes the development status of the heart assist system driven by an electronically-controlled vapor cycle engine termed the tidal regeneration engine. (NTIS)

377 (RCA-3582-17) COMPACT THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Progress Report No. 1 for the Period January 1, 1966–March 31, 1966. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). 1 May 1966. Contract AT(30-1)-3582. 45p. Dep. NTIS $5.25.

Declassified 6 Sep 1973.

Progress during the period from Jan. to April 1966 in the development of a compact thermoelectric generator is reported. The reference design using SiGe elements was developed and life testing of the components continued. (LCL)

378 (RCA-3582-22) COMPACT THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Progress Report No. 2 for the Period April 1, 1966–June 30, 1966. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). 1 Sep 1966. Contract AT(30-1)-3582. 86p. Dep. NTIS $7.50.

Declassified 7 Sep 1973.

Progress during the period from April to July 1966 in the development of compact thermoelectric generators is reported. (LCL)

379 (RCA-3582-38) COMPACT THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Progress Report No. 2 for the Period April 1, 1967–June 31, 1967. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). 15 Aug 1967. Contract AT(30-1)-3582. 48p. Dep. NTIS $5.50.

Declassified 6 Sep 1973.

Six additional thermoelectric generators were assembled with minor variations in components. These test devices have been placed on operational test in vacuum. One of these test structures was not mounted for test but is being examined metallurgically because of indications of higher than normal element-resistance. Tests continue on thermoelement assemblies to evaluate braze penetration and void presence in some of the bonds. Additional work is being done on hot stack components to reduce interdiffusion of metals by means of metallurgical barriers. Tests continue on heat-exchanger plate and flexible connector components for confirmation purposes. These components have essentially been firmed up but component life tests continue. (auth)

380 (RCA-3582-41) COMPACT THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Progress Report No. 3 for the Period July 1, 1967–September 30, 1967. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). 15 Nov 1967. Contract AT(30-1)-3582. 44p. Dep. NTIS $5.25.

Declassified 7 Sep 1973.

Program effort was redirected toward more component studies and less assembly of full modules. The principal increase of component effort was in the thermoelement assembly area where studies of alternate bonds and barrier layers were instituted. Effort in the beryllia ceramic area was increased to provide a higher quality product. Test and evaluation was continued on the flexible connector and on the hot and cold heat exchanger plates with satisfactory results. (auth)

381 (SLA-74-0086) GENERATION OF BUBBLES IN GLASS INSULATION LAYERS OF THE MC2730 RADIOISOTOPIC THERMOELECTRIC GENERATOR. Eagan, R. J.; Jones, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 19p. Dep. NTIS $4.00.

Hot-stage microscopy, residual gas analysis, and infrared transmission techniques were used to study the origin of bubbles or voids in the glass insulating layers of the MC2730 Radioisotopic Thermoelectric Generator (RTG). It was found that at temperatures above 1140^0K, H_2 gas was generated through the reduction of water in the glass by the SiGe alloy. It is suggested that voids were formed in those glasses which have low gas permeabilities because H_2 was trapped at the interface. The formation of these voids was eliminated by restricting the fabrication temperatures to below 1140^0K. (auth)

382 (WANL-TMI-1588) CONTACT RESISTANCE TEST THERMOELECTRIC MODULE. Phase I. Ettenson, N. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Nov 1965. 8p. Dep. NTIS $4.00.

Tests performed to determine the thermal contact resistance of Inconel X750, boron nitride, and Armo iron specimens used in the fabrication of thermocouple modules and the results obtained are reported. (LCL)

383 (WANL-TMI-1780) APPLICATIONS OF STATIC CONVERTERS IN POWER CONDITIONING. Hardies, C. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Apr 1967. 44p. Dep. NTIS $5.25.

The purpose of this report is to acquaint the thermoelectric generator design groups with some of the types of static converters and how they work. In addition, information is presented showing how to figure out the approximate efficiency, weight, and volume of a unit required for a given input voltage and power handling capability. Examples are included to show how one figures the approximate efficiency, weight, and volume of a unit for specified input voltage and power handling capability. The descriptions and data presented are for conventional dc to ac converters with square wave outputs. (WHK)

Facilities and Equipment

Refer also to abstracts 610, 652, and 1632.

384 (GERHTR-92) INVESTIGATION OF FLOW MECHANISMS IN CONICAL MODELS OF FLUIDIZED BEDS AND TRANSFER OF THE RESULTS TO HIGH-TEMPERATURE-COATING BEDS. A Study on the Coating of Nuclear Fuel Particles in Fluidized Beds. Kalthoff, B.; Gyarmati, E.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Dec 1973. Translation of JUL-1030-RW. 100p. Dep. NTIS $5.45.

Work performed under United States-German High Temperature Reactor Research Exchange Program.

The different states of movement of the fluid-solid particle system as occurring in coating of nuclear particle fuel in conical fluidized beds determine the transfer of momentum, heat and mass in the fluidized bed. To know the flow characteristics, therefore, is essential for the understanding of the complex processes which take place during coating. As experimental studies in actual coaters initially were impossible due to the high temperature levels of up to 2000°C, information on characteristic behavior of the fluidized bed was obtained from geometrically similar model beds. Based on principles in the mechanics of similarity the fluid-solid particle system was selected. Hence, results obtained in model tests could be correlated to hot fluidized beds by means of a dimensionless characteristic number describing the fluid-solid system. A second combination of characteristic numbers allows the characterization of the three states of a fluidizing regime, i.e., spouting, bubbling, and slugging. For examining the model test results in hot beds, a measuring device was developed applicable to both cold model beds and actual fluidized bed coaters; pressure oscillations originating in the beds could be made visible by means of electronics and their frequency measured. Coating experiments with different batches and at different temperature levels rendered this frequency to decrease with increase in bed height. Thus the frequency is an important index for the momentary state of fluidization of the fluid-solid particle system. (auth)

385 (NTO-I-0223) SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT FOR NES DESIGN DEMONSTRATION TEST. Phase II. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 21 Apr 1967. 53p. Dep. NTIS $5.75.

The primary purpose of Phase II of the NERVA Exhaust System (NES) Design Demonstration Test program is to integrate the Engine Test Compartment (ETC) into the Nuclear Exhaust System, to verify the duct dynamics using gaseous hydrogen and to evaluate exhaust plume thermal radiation effects on the test stand. The test program and requirements for the equipment to be used are described. (LCL)

386 (NTO-I-0223(Rev. A)) SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT FOR NES DESIGN DEMONSTRATION TEST. Phase II. Revision A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). May 1967. 58p. Dep. NTIS $6.00.

A revised version of the support operational requirements for the NERVA Exhaust System (NES) demonstration test is presented. (LCL)

387 (NTO-R-0038) SHIELDING INTEGRITY CHECK (SIC) TESTS FOR THE E-MAD FACILITY. Phase I. Final Report. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Oct 1965. 37p. Dep. NTIS $5.00.

Data and results obtained from the Phase I portion of the Shielding Integrity Check (SIC) Tests at the E-MAD building are presented. This portion of the SIC tests was performed by NERVA Test Operations (NTO). The Phase I portion, which included the main Hot Disassembly Bay (Room 122) and the Crane Maintenance Balcony (Room 306), was performed to disclose any defects in shielding which might be present. The violations of the shielding integrity found were reviewed by a Test Evaluations Committee (TEC) to determine whether a construction contractor type fix or the establishment of administrative controls would be required. There were a total of 13 violations of shielding integrity found in the Phase I portion of the SIC tests. Five (5) of these violations involved leakage through blocked-up windows. It was determined that 3 of the violations required a construction contractor type fix and that 2 violations could be provided for by establishment of appropriate administrative controls. One violation was apparently due to a minor lead brick stacking error which was subsequently corrected. The 2 remaining violations were the result of an existent condition, constructed as designed, which will be repaired by NTO. All of the violations, with the exception of the last 2 itemized above and a single area on the West Wall of the Main Hot Disassembly Bay, were repaired, rechecked and found to be satisfactory. (auth)

388 (NTO-R-0039) SHIELDING INTEGRITY CHECK (SIC) TESTS FOR THE E-MAD FACILITY. Phase III and III Addendum. Final Report. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Oct 1965. 27p. Dep. NTIS $4.50.

Data and results obtained from the Phase III and Phase III Addendum portions of the Shielding Integrity Check (SIC) tests at the E-MAD Building are reported. These portions of the SIC Tests were performed by NERVA Test Operations (NTO). The Phase III portion, the Hot Hold and Transfer Tunnel (HHTT) and the Cell Service Areas (CSA), and the Phase III Addendum portion, the blocked-up transfer drawer pass-throughs and the Engine and Core Disassembly Cells, were tested to disclose any defects in shielding which might be present. The violations of shielding integrity found were corrected by physical reconstruction and/or repair (construction contractor fixes), or by establishment of administrative controls to be enforced during an operational phase, depending upon the severity of the violation. There were no violations of shielding integrity found in the Phase III portion of the SIC tests which required a construction contractor type fix, and only the administrative type operational controls will be required to assure personnel safety. There were two (2) violations of shielding integrity found in the Phase III Addendum portion of the SIC tests which were of sufficient magnitude to require a construction contractor type fix. These violations were repaired and re-checked. The repaired violations were found to possess adequate shielding integrity. (auth)

389 (NTO-R-0043) ETS-1 GN_2 FLOW TEST. Younger, B. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Sep 1965. 44p. Dep. NTIS $5.25.

The gaseous nitrogen flow tests described in this report were conducted for the purpose of: experimental determination of the polytropic exponent, n, in order to provide the best possible basis for the evaluation of gaseous storage requirements at ETS-1; and to verify the gaseous flow rate calculations performed in connection with the impending NES integrated test program. The polytropic exponent, n, for nitrogen was found to vary from 1.33 during maximum flow to 1.05 during the lower flow rates with a reasonable value of 1.25 for the operation region of concern. This would indicate a reasonable value of 1.4 for GHe. The flow rates were found to be 30% higher than the preliminary calculations. Since the preliminary calculations were based on a gas temperature of 100°F and a system 40' longer than the one tested, this would account for the higher flow rate obtained. This indicated that the assumptions made and method used for calculation of the system flow rate from empirical data are correct and on the conservative side. (auth)

390 (NTO-R-0062) SHIELDING INTEGRITY CHECK (SIC) TESTS FOR THE E-MAD FACILITY. Phase II and Phase II Addendum. Final Report. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Mar 1966. 19p. Dep. NTIS $4.00.

Data and results obtained from the Phase II Portion of the Shielding Integrity Check (SIC) Tests at the E-MAD building are presented. This portion of the SIC tests was performed by NERVA Test Operations (NTO). The Phase II Portion, the Postmortem cell walls (except for the Postmortem Intercell walls), and the Phase II Addendum Portion, the mating surfaces of the shielding door 173-1 between the Cell Service Area (CSA) and Room 176, were performed to disclose any defects in shielding which might be present. The violations of shielding integrity found were corrected by physical repair (construction contractor fixed), or by the establishment of administrative controls to be enforced during an operational phase, depending upon the severity of the violation. There were 4 violations of shielding integrity found in the Phase II Portion of the SIC tests. One of these violations was of sufficient magnitude to require a construction contractor type fix, and 3 violations will require only the administrative type operational controls to assure personnel safety. The one violation requiring a construction contractor type fix was repaired by the contractor and rechecked. The repaired violation was found to possess adequate shielding integrity. There was one violation of shielding integrity found in the Phase II Addendum Portion of the SIC tests which will require only the administrative type operational controls to assure personnel safety. (auth)

391 (NTO-S-0035) WELDING STANDARDS, FINAL ISSUE. Phillips, M. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 17 Oct 1968. 65p. Dep. NTIS $6.25.

Welding standards for the NERVA program are presented and include standards for qualification of Welders and NDT personnel; requirements for nondestructive testing (NDT), cleanliness and identification of welds; welding procedures; and repairs. (LCL)

392 (NTO-T-0002) ETS-1 CONSOLE OPERATIONS MANUAL: Gas Fill and Service GFS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Aug 1967. 45p. Dep. NTIS $5.25.

The purpose of this manual is to describe in detail the functions of the controls on the control consoles and panels associated with the data acquisition system, the ETS-1/A&E data link, and the ETS-1 test diagnostic center. It describes in general the systems

being controlled and discusses the system operational philosophy. (auth)

393 (NTO-T-0005) ETS-1 CONSOLE OPERATIONS MANUAL. Lead Instrumentation Engineer LIE. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 45p. Dep. NTIS $5.25.

The purpose of this manual is to describe in detail the functions of the controls on the control consoles and panels associated with the data acquisition system, the ETS-1/A&E data link, and the ETS-1 test diagnostic center. It describes in general the systems being controlled and discusses the system operational philosophy. (auth)

394 (NTO-T-0010) ETS-1 CONSOLE OPERATIONS MANUAL. Lead Reactor Engineer LRE. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 98p. Dep. NTIS $8.00.

The purpose of this manual is to describe in detail the functions of the controls on the control consoles and panels associated with the data acquisition system, the ETS-1/A&E data link, and the ETS-1 test diagnostic center. It describes in general the systems being controlled and discusses the system operational philosophy. (auth)

395 (NTO-T-0025(Vol. 1)) ETS-1 CONTROL POINT GENERAL INDOCTRINATION COURSE. Volume I. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 208p. Dep. NTIS $13.50.

This volume of the indoctrination course for NERVA Engine Test Stand-1 (ETS-1) control point operators includes information on: NERVA Program orientation; NRDS facilities; ETS-1 facility description; facility process systems; test stand process systems; engine test compartment; nuclear exhaust duct; steam generator system; facility duct and shield monitor; system control hardware; facility control system console operation; electrical power; communication system; and television system. (LCL)

396 (NTO-T-0025(Vol. 2)) ETS-1 CONTROL POINT GENERAL INDOCTRINATION COURSE. Volume II. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 206p. Dep. NTIS $13.50.

Data are presented on the design and operation of the following components of the NERVA Program Engine Test Stand-1: overall system control hardware; data acquisition system; neutronics system; test stand control system; railroad transport system; and test stand adapter. (LCL)

397 (NTO-T-0025(Vol. 3)) ETS-1 CONTROL POINT GENERAL INDOCTRINATION COURSE. Volume III. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 209p. Dep. NTIS $13.50.

This volume of the indoctrination course for NERVA Engine Test Stand-1 (ETS-1) control point operators includes information on: nuclear physics; reactor physics; reactor physics and control theory; reactor description; engine system components; engine operating conditions; re-entry procedure; ETS-1 safety system; test operations; and documentation. (LCL)

398 (TID/SNA-479) FLIGHT AND GROUND TEST CONTROL INTEGRATION PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. Contract SNP-1. 57p. Dep. NTIS $6.00.

The functions to be accomplished in providing the control system in support of the NERVA engine testing at ETS-1 are described, and serve the project engineer as a source of information for the planning and design of a unit of test support equipment identified as the ground test control system. The overall engine control system integration studies required and programs used as guides by the equipment and system designers are discussed. (auth)

399 (TID/SNA-1206) SPECIFICATION FOR HIGH PRESSURE GAS VESSELS. (Space Nuclear Propulsion Office, Cleveland Extension, 2100 Brookpark Rd., Cleveland, OH. (USA)). May 1967. 21p. Dep. NTIS $4.25.

This specification, together with drawings, covers the design, fabrication, inspection, testing, cleaning, and acceptance of cylindrical, high pressure gas storage vessels. (auth)

400 (TID/SNA-1315) CHEMICAL STEAM GENERATING SYSTEM. Operation and Maintenance Manual. Festa, T. E. (Shawnee Industries, Inc., Okla. (USA)). Mar 1962. 169p. Dep. NTIS $11.50.

For Aerojet-General Corp., Azusa, CA.

Operating instructions and background information necessary to safely operate the chemical steam generator are presented. This steam generator is heated by the continuous combustion of propane with oxygen and is used to provide drive media for the operation of the exhaust system in the NERVA Engine Test Stand No. 1. (LCL)

401 (TID/SNA-1469) STATUS OF SUB-SONIC TURN INVESTIGATION. McFarland, B. L.; Nelson, R. E.; Patmor, G. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). 8 Mar 1963. 27p. Dep. NTIS $4.50.

Tests performed on four different configurations of scale models of the subsonic flow elbow for the NERVA exhaust duct system are described, and ejector performance is predicted. (LCL)

402 (TID/SNA-1470) EVALUATION OF EJECTOR SYSTEMS FOR ETS-1. Interim Report, 1 October 1962–31 January 1963. Nelson, R. E.; Patmor, G. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Feb 1963. 44p. Dep. NTIS $5.25.

Work done during 1962 to define a duct configuration of the Engine Test Stand-1 (ETS-1) is presented. Four basic ejector systems were tested. The tests are described, and the test results are summarized. (LCL)

403 (TID/SNA-1476(Vol. 1)) VOLUME I. TECHNICAL DISCUSSION. NCS-211A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Nov 1962. 81p. Dep. NTIS $7.25.

NERVA program design studies of the engine system, propellant feed system, thrust chamber assembly, system irradiation experiments, and special test equipment are discussed. (LCL)

404 (TID/SNA-1476(Vol. 2)(Pt. 1)) VOLUME II. PROGRAM PLAN. Part I. Technical Administration Documents. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Nov 1962. 104p. Dep. NTIS $8.25.

Plans for continuing the design improvements fabrication, and performance testing of the NERVA engine and engine test facilities during 1963 are presented. (LCL)

405 (TID/SNA-1559) CRITERIA FOR PRELIMINARY DESIGN OF ENGINE/STAGE TEST STAND 2-3. Finger, H. B. (USAEC/NASA Space Nuclear Propulsion Office, Washington, D. C. (USA)). 20 Jan 1967. 123p. Dep. NTIS $9.25.

Design criteria are presented for a nuclear rocket engine test complex to be called Engine Test Stand 2 and 3 which will be used for testing large NERVA engine systems. (LCL)

406 (TID/SNA-1634) PRELIMINARY SERVICE SYSTEMS REQUIREMENTS FOR THE NRDS VEHICLE TEST STANDS. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). 1 Dec 1962. 41p. Dep. NTIS $5.25.

Preliminary service systems requirements for the NRDS Vehicle Test Stands are defined. Included are preliminary cooling-water requirements, preliminary propellant- and pressurization-systems design requirements, and preliminary data for electrical power and other related-systems requirements. These systems, in part, shall constitute the Central Service Area and, except for the process-water storage tank, will be located generally in the area between and as close to the Vehicle Test Stands as is compatible with quantity-distance criteria selected by NASA and/or other applicable documents and the topography of the test site. (auth)

407 (TID/SNA-1635) REQUIREMENTS FOR STAGE STATIC TEST FACILITIES NRDS, NEVADA. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). 28 Dec 1962. 121p. Dep. NTIS $9.25.

Design requirements for the Stage Static Test Facilities at the NERVA Reactor Development Station are presented. These facilities include the test control center and its associated tunnels, Engine/Vehicle Test Stand No. 3, and a termination area. (LCL)

408 (TID/SNA-1640) TEST CELL A INDOCTRINATION COURSE. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 5 May 1964. 181p. Dep. NTIS $12.25.

409 (TID/SNA-1670) DESCRIPTION OF ENGINE TEST STAND ETS-1 INSTRUMENTATION AND CONTROL SYSTEMS CAPABILITIES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Sep 1963. 87p. Dep. NTIS $7.50.

The description is based on the present status of the design activity and is subdivided into two parts: facilities system and data acquisition system. The facilities system is composed of those systems necessary for safety, control, monitoring, communications, electrical power, and transmission of control and instrumentation signals in support of the nuclear engine tests using cryogenic fluids. The power generation and distribution system is not a part of the I&C contractor's responsibility, but is included to show the integration and operational concepts relative to the total system. The data acquisition system is composed of systems necessary to record and document performance and information needed in the analysis of test results. (auth)

410 (TID/SNA-1672(Vol. 1)) INSTRUMENTATION AND CONTROL SYSTEM DESIGN CRITERIA. Test Cell ETS-1

NNRDC. Volume I. Criteria. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Jun 1962. 566p. Dep. NTIS $31.50.

This document establishes design concepts, criteria, and preliminary design for the Remote Engine Control System, the Facilities Operations and Controls Systems, and the Data Acquisition System for the NNRDC Test Cell ETS-1. Included are drawings necessary to depict system and subsystem concepts and preliminary design; not included however, are hardware fabrication drawings, which are tasks of detailed design, and represent the point of departure between criteria and preliminary design, and detailed design. In addition, the integration of these systems into the complete facility is analyzed with respect to overall facility missions, objectives, and system interfaces. (auth)

411 (TID/SNA-1672(Vol. 2)) INSTRUMENTATION AND CONTROL SYSTEM DESIGN CRITERIA. Test Cell ETS-1 NNRDC. Volume II. Criteria Drawings. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Jun 1962. 252p. Dep. NTIS $15.75.

Criteria drawings are presented for the following: instrument and control system; remote engine control system; facility operations and control systems; data acquisition system (electronic); and data acquisition system (photographic). (TFD)

412 (UCRL-51755) SEISMIC RESPONSE AND FAILURE ANALYSES OF A MIXED-OXIDE FUEL FABRICATION PLANT. Tokarz, F. J.; Murray, R. C.; Sorensen, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1975. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.00.

The structural integrity and possible failure modes of mixed-oxide fuel fabrication plants (MOFFP) subjected to different ground-motion intensities ranging from 0.1- to 1.0-g peak accelerations was studied. To perform this study, calculation models of safety-related systems to be used in the analysis were developed. Both elastic and inelastic dynamic response analyses for both horizontal and vertical ground motion were performed. Conclusions drawn regarding the structural integrity for the model MOFFP are as follows: (1) no structural damage at ground motions less than 0.4 g; (2) severe structural damage at 0.4 to 0.5 g; (3) complete building collapse at greater than 0.5 g; and (4) building collapse before equipment failure. (auth)

413 (WANL-TME-219) HVAC SYSTEM REQUIREMENTS FOR PHASE II OF THE E-MAD FACILITY. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Dec 1962. 2p. Dep. NTIS $4.00.

The equipment proposed for controlling air flow in the NERVA E-MAD facility hot cells is evaluated and found unacceptable according to the hot cell operation criteria. (LCL)

414 (WANL-TME-384) REACTOR SHIPPING DEMONSTRATION PROGRAM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Jun 1963. 18p. Dep. NTIS $4.00.

The program for demonstrating the feasibility of assembled NERVA reactor shipment is outlined. (auth)

415 (WANL-TME-1693) PRE-PRODUCTION TESTING OF THE PERIGUARD III SYSTEM. Parsons, L. E.; Morin, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 54p. Dep. NTIS $5.75.

416 (WANL-TME-1732) SELF-CONTAINED ELECTRON BEAM WELDING GUN FOR IN-ORBIT WELDING EXPERIMENT. Final Report. Schumacher, B. W.; Lowry, J.; Hassan, C.; Elder, A.; Seaman, F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1968. 293p. Dep. NTIS $17.75.

The design and testing of an electron gun with a built-in high reliability power conditioning unit for the electron beam welding of pressure-tight structures in space are described. (LCL)

417 (WANL-TMI-668) MARMON CLAMP. Morgan, L. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 May 1963. 7p. Dep. NTIS $4.00.

Equations developed for the stress analysis of the Marmon Clamp are presented. (LCL)

418 (WANL-TMI-834) MEASURING THE MECHANICAL PROPERTIES OF AN INSTRUMENTED TIE ROD. Work Order 48053. Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Oct 1963. 3p. Dep. NTIS $4.00.

One instrumented tie rod (B-347, Inconel X750) was submitted to the Engineering Mechanics Section for the purpose of measuring the mechanical properties of the material. One end of the rod was threaded into an adaptor and the other was supported on a support cone. The load was applied at a uniform rate and failure occurred approximately $\frac{1}{16}$" above the uppermost thread. The load vs elongation curve is included. The yield strength for 0.2% offset was 1013 lb. or a stress of 105,500 psi. (auth)

419 (WANL-TMI-894) TENSION PROPERTIES OF TIE RODS. Part No. 944C732 Spec. Grade. Quality Control Request No. 274. Allison, H.; Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Dec 1963. 3p. Dep. NTIS $4.00.

Fifteen tie rods from V500 and V600 series were submitted for tension test by quality control. All pertinent data from the tests are tabulated. The yield strength properties of V500 and V600 series tie rods are somewhat higher than those reported for all other V-series rods (5 to 10% greater). (auth)

420 (WANL-TMI-1077) CRYOGENIC MOCK-UP LOOP DESIGN STUDY. Cadoff, H. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 May 1964. 11p. Dep. NTIS $4.00.

The test fixtures and components to be used at the Plum Brook Reactor Facility (PBRF) for high flux reactor testing of NERVA components at cryogenic temperatures must be capable of withstanding both the cryogenic and high gas flow conditions. Therefore, a cryogenic loop mock-up system using GN_2 was constructed and evaluated for the feasibility of its use in determining the suitability of test fixture design and in isolating cryogenic effects on test equipment prior to PBRF testing. The cryogenic loop mock-up system using GN_2 to simulate GH_2 flow was found to be feasible. (LCL)

421 (WANL-TMI-1407) EML-69 SUPPORT BLOCK MECHANICAL AND THERMAL TESTS, INTERIM REPORT. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Feb 1965. 2p. Dep. NTIS $4.00.

Compression strength tests were performed on two NERVA reactor support blocks. One, tested at 4000°R, failed at 8100 lb. The second, tested at 4500°R, failed at 7600 lb. (LCL)

422 (WANL-TMI-1447) SUB-SCALE STAVE BARREL PRESSURE TESTS (EML-73). Krebs, A. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Apr 1965. 26p. Dep. NTIS $4.50.

Graphite stave-barrels were pressure tested to verify calculated buckling pressures and to provide data on the relative merits of stave and one-piece barrels. The testing method is described. A high-pressure hand-operated water pump and bourdon gage was used for the pressurizing system. These tests demonstrated the suitability of the stave-barrel design for a particular mode of barrel buckling failure. (LCL)

423 (WANL-TMI-1448) TENSILE LOADED THERMAL CYCLED HLM GRAPHITE THREADS MESHED WITH ALUMINUM 2024-T6 BOLTS. Morin, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 May 1965. 9p. Dep. NTIS $4.00.

The effects of thermal stress caused by heating an HLM graphite block with $\frac{5}{16}$-24 UNF-2B threads and 2024-T6 aluminium $\frac{5}{16}$-24-3A bolts to 850°R was investigated. The graphite blocks were machined with two threaded holes in each block. The bolts were machined, and tightened into each block to hold a lateral spring support bracket which covered a leaf spring. After heating and stabilizing the temperature of the assembly at 850°R, tensile loads were applied to the bolts in a testing machine. All failures occurred in the graphite material. The threaded sections withstood an average load of 1125 lb, which exceeded thread design shear load. (LCL)

424 (WANL-TMI-1506) NRX-A REACTOR-IN-VESSEL QUALIFICATION TEST. Burack, R. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jul 1965. 9p. Dep. NTIS $4.00.

Qualification shock tests, using free-fall drop, were performed on the NRX-A Reactor-in-Vessel shipping container. A dummy mass was used to simulate the reactor. The tests are described and the data obtained are summarized. (LCL)

425 (WANL-TMI-1546) EVALUATION TEST OF A BRAZED BIMETALLIC JOINT. Bove, G. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Sep 1965. 3p. Dep. NTIS $4.00.

An evaluation test of a brazed bimetallic joint of 6061-T6 aluminum and T-304 stainless steel was conducted. This type joint is being considered for a bimetallic transition sleeve required in the pressure vessel seal block design. Pressure tests, temperature cycling tests, impact tests and leak tests were included in this evaluation. The test results indicate the mechanical strength of this joint to be satisfactory for operating pressures of 750 psig. (auth)

426 (WANL-TMI-1599) PROTECTION CUP CORROSION. DeZubay, E. A.; Layland, E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1965. 2p. Dep. NTIS $4.00.

The final design of tie rod hardware for the engine test facility includes a protection cup surrounding the tie rod button, support washer, and support cup. This protection cup is directly impinged upon by reactor effluent streams. Tests to be performed to determine the corrosion resistance of the protection cups under simulated reactor conditions are specified. (LCL)

427 (WANL-TMI-1744) TESTS ON CARBIDE COMPOSITION CUPS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Dec 1966. 2p. Dep. NTIS $4.00.

428 (WANL-TMI-1751) PARAMETRIC ANALYSIS OF HEAT PIPES. Parker, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [1967]. 41p. Dep. NTIS $5.25.

The performance capabilities and limitations of heat pipes are assessed through a parametric analysis and, to a limited extent, comparison with experimental heat pipe results. A number of parametric curves are presented to provide quantitative insight regarding the physical phenomena that govern heat pipe operation and to provide heat pipe design guidelines. The principles of heat pipe operation are briefly discussed along with a concise history of their development. (auth)

429 (WANL-TMI-1753) VERIFICATION OF HEIGHT VERSUS ACCELERATION CURVE ON THE HIGH IMPACT SHOCK MACHINE (MODEL SH-3). Mendicino, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [1967]. 44p. Dep. NTIS $5.25.

The equipment and procedures used to verify that the shock machine performs as per calibration specifications are presented, and a standard procedure for running a shock test with this machine is established. (LCL)

430 (WANL-TMI-1764) TESTS ON CARBIDE COMPOSITION CUPS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Apr 1967. 2p. Dep. NTIS $4.00.

431 (WANL-TMI-1765) LOAD TEST, GE MATERIAL EXTRUDED TUNGSTEN CUPS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Apr 1967. 2p. Dep. NTIS $4.00.

432 (WANL-TMI-1788) IRREGULAR TUNGSTEN CUPS PROOF TESTS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 May 1967. 2p. Dep. NTIS $4.00.

433 (WANL-TMI-1792) ROOM TEMPERATURE LOAD TESTS. Brickman, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jun 1967. 2p. Dep. NTIS $4.00.

Two-sets of vapor-deposited tungsten cups were subjected to room temperature loading to determine the crack initiation loads and ultimate strength of the cups and associated hardware. Both specimens showed no cracks in the short cup but the initial of radial cracks in the long cup after the point of load drop off, i.e., more than 4000 lb. load. (LCL)

434 (WANL-TMI-1798) BLIND RIVET TEST. Thomson, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Jun 1967. 8p. Dep. NTIS $4.00.

Tests were performed to determine if a hole of approximately 0.190-in. diam in the A6 spring retainer cap could be closed and sealed with a blind rivet. It was concluded that a polished, short blind rivet could be used to produce a no-leak seal. (LCL)

435 (WANL-TMI-1799) NR-1 NUT TO SUPPORT STEM SEAL TEST. Thomson, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Jun 1967. 7p. Dep. NTIS $4.00.

A stainless steel-304 support seal for use in a nut/bolt assembly in the NR-1 plenum was tested in a helium atmosphere under a 500 psid pressure gradient at ambient and cryogenic temperatures, and with a 600°R gradient across the seal interface. All assemblies did not leak under any test condition when a 200 in-lb torque was applied to the nut/bolt assembly. (LCL)

436 (WANL-TMI-1880) REPORT OF MAGNETIC RAIL CLEANER OPERATIONS IN THE REACTOR ASSEMBLY BAY. Schaedel, C. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1968. 10p. Dep. NTIS $4.00.

A magnetic particle catcher is described that catches magnetic particles from the crane wheels and rails in the reactor assembly bay eliminating the probability of steel particles falling in the vicinity of the reactor or the pressure vessel assembly. This device has worked exceptionally well and is recommended for use in other facilities to prevent particulate contamination and to improve the life of crane wheels and rails. (auth)

437 TRITIUM EXTRACTION PLANT OF THE LAUE LANGEVIN INSTITUTE. Pautrot, P.; Arnauld, J. P. Trans. Amer. Nucl. Soc.; 20; 202-205(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

438 FREEZE SEAL SODIUM VALVE. Ebuchi, S.; Kazama, T. (to Okano Valve Seizo Kabushiki Kaisha). British Patent 1,371,799/B/. 30 Oct 1974. Filed Date 15 Nov 1971. 4p.

Reference is made to valves for use in sodium cooling circuits. By "freeze sealing" is meant freezing the sodium which is present around the valve stem to avoid leaks. Conventional freeze sealing systems have utilized the freezing of sodium located in the stuffing box, but oxide can be precipitated on the valve stem, making opening and closing of the valve more difficult. The valve described has a packing ring or rings located in a stuffing box and providing a large number of passages for liquid sodium. This ring scrapes off sodium and/or oxide adhering to the valve stem. The packing ring is of material resistant to sodium. Various alternative forms of packing rings are described. (UK)

439 HEAT EXCHANGERS: DESIGN AND THEORY SOURCEBOOK. Afgan, N. H.; Schluender, E. U. (eds.). New York; McGraw-Hill Book Company (1974). 908p. $39.50.

Thirty-five papers on heat transfer theory and heat exchanger design and performance are presented. A separate abstract was prepared for each of 3 papers. The remaining 32 papers were not in scope for NSA. (LCL)

440 SOME EXTRA-HIGH CAPACITY HEAT EXCHANGERS OF SPECIAL DESIGN. Forgo, L. (Design Bureau for Industrial Power and Heat Supply, Budapest). pp 101-119 of Heat Exchangers: Design and Theory Sourcebook, Afgan, N. H. (ed.). New York; McGraw-Hill Book Company (1974).

Recent technical advances in developing high-capacity power generating equipment, in using new heat transfer media, in seawater desalination, and in chemical processing require the development of higher unit-capacity heat exchangers. Up-to-date solutions illustrating the progress made in the development of such heat exchangers is discussed and suggestions are made which may be of interest in this field. Specific heat transfer systems discussed include systems for air-cooled condensing power plants, multiple reheating cycles for steam turbines, and systems using liquid lead as the transfer medium. (LCL)

441 STUDY ON THE RELEASE OF DUSTS INITIALLY DEPOSITED ON GLASS FIBRE FILTERS. Dupoux, J.; Charuau, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). pp E39.1-E39.6 of I. Congres Mondial de la Filtration. Paris; Technique et Documentation (1974). (In French).

From 1st World Filtration Congress; Paris, France (14 May 1974).

On the occasion of the incident that occurred in the Saint Laurent-1 reactor, the EDF fitted in the reactor a filtering system composed of 1600 glass wool candles to scrub the gases. The development of this type of filter is described. The tests were carried out in air at 220°C, at atmospheric pressure using a Zn sulfide aerosol. The measurements made with non-impregnated filters and filters impregnated with silicone oil showed that after treatment the release rate was from 50 to 1000 less (according to the treatment method used). The application must be made preferentially on the upstream side of the filter and as a rather fine aerosol. (FR)

442 ONE-PIECE GLOVEBOX GLOVES WITH A THIN HAND AND A THICK SLEEVELET. (to Piercan, le Latex de France). French Patent 2,195,509/E/. 7 Aug 1972. 6p. (In French).

443 A SYSTEM FOR PROTECTING AND STABILIZING LOADS. (to Messier-Hispano). French Patent 2,202,564/D/. 6 Oct 1972. 7p. (In French).

The invention relates to the protection and stabilization of loads of various types. Its object is a system constituted by dampers with thresholds in opposite directions, capable of being compressed from their threshold position and mounted obliquely against the load lower surface so as to form, between the load and its support, an isostatic or hyperstatic triangulation, such that the load is "stabilized" when all the dampers are in their threshold position and such that the load tends to resume the "stabilized position" whenever outer biases are cancelled. The

invention can be applied in particular to missiles and to nuclear generators. (FR)

Lasers

Refer also to abstracts 289, 1642, 1644, and 2141.

444 (AD-784868) DOUBLE-PULSE LASER INTERACTION EXPERIMENTS. Final Report, 26 Apr-26 November 1973. Hall, R. B.; Maher, W. E.; Nelson, D. J. (Boeing Aerospace Co., Seattle, Wash. (USA)). Jul 1974. Contract F29601-73-C-0085. 122p. (D-180-17844-1; AFWL-TR-73-296). NTIS $4.50.

A double-pulse CO_2 laser system has been constructed which emits 15 J in each of the two pulses with a controllable pulse separation which can be varied from simultaneous to several seconds. With this system, high-power laser effects at solid surfaces in air are investigated at atmospheric pressure. Ignition thresholds of laser-supported detonation waves using thin foil targets are investigated for single laser pulses. The energy released in a laser-supported detonation wave leads to an air blast wave in the space near the target after the laser power has decayed. As a consequence, the gas density is reduced to approximately 1% of its ambient value and leads to an observed enhanced coupling for a second laser pulse. In the limit of perfect coupling, calculations are made of the expected temporal variation of surface temperature. Various experimental measurements are made of the high-temperature region near the target surface. (auth)

445 (AD/A-000853) CARBON MONOXIDE CHEMICAL LASER RESEARCH. Quarterly Technical Report No. 2, 1 June-1 September 1972. Jeffers, W. Q. (McDonnell Douglas Research Labs., St. Louis, Mo. (USA)). 1 Sep 1972. Contract DAAH01-72-C-0578. 56p. NTIS $4.25.

The theoretical treatment of the cw CO chemical laser (Task 3) is the main subject of this report. In order to investigate the collisional relaxation effects occurring in CO chemical laser media, the master relaxation equations for CO-M systems were solved by computer calculations. The complete theory, including fluid flow, chemical kinetics, relaxation, and optical properties, is described in detail. The zero optical intensity theory is used to model the MDRL CO chemical laser for two cases of interest, i.e., with and without CO (300°K) injection into the reacting stream. (GRA)

446 (AD/A-002132) HELP: A MODEL FOR EVALUATING THE FEASIBILITY OF USING VARIOUS CHEMICAL REACTION SYSTEMS AS ELECTRONIC LASERS. Herbelin, J. M.; Cohen, N. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Sep 1974. Contract F04701-74-C-0075. 46p. (SAMSO-TR-74-213). NTIS $3.75.

An analytical model for estimating the minimum requirements of a chemically pumped electronic laser is developed. From a knowledge of the basic spectroscopic and thermodynamic properties of a particular reaction, the model can quickly classify the system according to the feasibility of generating stimulated emission at different possible wavelengths. Sample calculations of the reactions of barium atoms with nitrous oxide and nitrogen dioxide show that the model is sufficiently sensitive to distinguish between very similar systems and, therefore, should be useful in providing classification criteria in the search for a chemically pumped electronic laser. (GRA)

447 (AD/A-002193) ANALYSES OF X-RAY LASER APPROACHES. 2. Quasistationary Inversion on K-Alpha Intershell Transitions. Elton, R. C. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 29p. (NRL-MR-2906). NTIS $3.75.

In search for an x-ray laser scheme capable of operating in a quasi-cw mode, a suggested k alpha-innershell scheme is reexamined using recently calculated rates. This scheme involves the decay of a k-shell vacancy followed by a more rapid (for certain elements) l-vacancy decay, which maintains the inversion. The present analysis indicates that the scheme is only marginally feasible unless a depletion of resonant absorbers is accomplished through line shifts associated with multiple ionization following k-vacancy production. The need for a more complete numerical model is indicated. The pumping requirements for overcoming photoionization losses in the beam and the associated gain conditions are estimated for three elements, namely silicon, calcium and copper. It is concluded that photoionization pumping in a selective energy band is required, with emission approaching the blackbody level. A multiline heavy-ion plasma source is suggested. (GRA)

448 (AD/A-002209) SCALING OF PARAMETERS AND RESONANCE SELF-ABSORPTION IN CO LASERS. Lacina, W. B.; McAllister, G. L. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Sep 1974. Contract N00014-72-C-0043. 30p. NTIS $3.75.

High optical extraction efficiencies for CO electric discharge lasers have been theoretically predicted and experimentally demonstrated. Considerable interest for military applications has resulted in programs for development of both pulsed and cw CO EDL's with high power and high energy objectives. In order to make realistic performance predictions for potential device design, it is necessary to understand how these devices scale in volume, pressure, and other parameters. Several generalizations that result from parametric scaling of the CO laser kinetics are reported and compared with experimental data from an e(-)-beam stabilized device. Scaling to high energy and high power systems is discussed. The limitations on high pressure or line-selected operation that may be imposed by resonant self-absorption in the CO medium is discussed. Preliminary investigations suggest that this effect may be an important pressure-dependent mechanism, with possible consequences for attainment of line selection objectives. (GRA)

449 (AD/A-002210) SPECTRAL LINE SELECTION OF CARBON MONOXIDE LASERS. Rice, D. K. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Sep 1974. Contract N00014-72-C-0043. 21p. (NRTC-74-44R). NTIS $3.25.

An intracavity water vapor cell was used to perform spectral line selection of carbon monoxide lasers. The technique was demonstrated with a low pressure longitudinal discharge laser operating in the cw and repetitive Q-switched modes and with an electron beam stabilized pulsed laser. The cell containing an appropriate amount of water vapor limited laser action in a vibrational band to those rotational lines having predicted high atmospheric transmittance. (GRA)

450 (AD/A-002276) ELECTRO-OPTICS VS. MAGNETO-OPTICS: POWER CONSIDERATIONS. Final Technical Report, 15 January 1973-30 Jun 1974. Reisinger, A. R.; Powell, C. G.; Tseng, S. C. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). Nov 1974. 65p. NTIS $4.25.

Conventional calculations of the power per unit bandwidth, based on the evaluation of the energy stored in the active crystal, indicate that magneto-optic modulators might be more attractive than their electro-optic counterparts. However, these calculations do not take into account the dynamical response of an assembly of spins placed in a magnetic field. Whether magnetization reversal takes place by coherent rotation or domain wall motion, the switching time decreases with increasing modulating field amplitude. This behavior is expected on a theoretical basis and is well confirmed by experiments. As a corollary, the bandwidth of A M-O device can be pushed upwards only at the cost of increasing power consumption. With presently available films, the power requirements are such that magneto-optics does not appear to be competitive with electro-optics for the construction of wideband, low power, integrated optical modulators. (GRA)

451 (AD/A-002462) INVESTIGATION OF ULTRAVIOLET PHOTOIONIZATION SUSTAINED DISCHARGE FOR GAS LASERS. Semiannual Technical Report, 1 January-30 June 1974. Lind, R. C. (Hughes Research Labs., Malibu, Calif. (USA)). Aug 1974. 57p. NTIS $4.25.

The objectives of this program are to investigate and improve ultraviolet (uv) photoionization plasma conditioning techniques, to perform the demonstration of a uv sustained electrical discharge atmospheric pressure CO_2 laser, and to establish scalability limits. Experiments employing small scale discharge volumes established that in excess of 200 J/l-atm could be input to 1 atm CO_2 laser mixture by the uv photoionization of an added low ionization potential organic molecule. Power extraction and small signal gain measurements were undertaken. Output energies in excess of 45 J/l-atm with pulse lengths to 37 microsec have been achieved. The limits of scalability of the uv sustained plasma conditioning technique are now being addressed. A large volume ($20 \times 20 \times 100$ cc) discharge device has been constructed with initial testing under way. (GRA)

452 (AD/A-002472) DESIGN OF IR LASER WINDOWS FOR CRYOGENIC LASERS. Biricikoglu, V. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Nov 1974. 22p. (NRTC-002472). NTIS $3.25.

The first part of the report derives expressions for thermal stresses in ir laser windows subjected to uniform cooling. It is shown that the radial contraction effects produce negligible stresses in the window. Fracture of the window is caused by highly localized shear stresses due to axial contraction of the window. A nondimensional plot is given for the determination of the maximum interface shear stress. The second part of the report summarizes the results of CaF_2 window cool-down experiments. The results indicate that at least two types of adhe-

sives are suitable for use in cryogenic window assemblies. Based on the above results, CaF_2 laser window assemblies have been designed for use in cryogenic CO electric discharge lasers. These windows have been subjected to thermal cycling between room and LN_2 (77°K) temperatures over the past two years with satisfactory performance. (GRA)

453 (AD/A-002477) uv GAS LASER INVESTIGATIONS. Semiannual Technical Report. Bhaumik, M. L.; Ault, E. R. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Nov 1974. 41p. NTIS $3.75.

The results of an intensive study of the high power characteristics of the Ar-N_2 laser are described. A kinetic model predicting efficiencies as high as 4% is developed and contrasted to a series of experiments carried out concurrent with the calculations. Excitation, energy transfer, and energy levels are discussed. Laser energies as high as 0.23J at powers of 10 MW have been obtained with the Pulserad 535, A 3 MeV, 60 kA, 50 ns electron gun supplied by DNA. This output was obtained at an estimated efficiency of 2%. The laser oscillates on 2 lines, 3577Å and 3805Å, sequentially. The implications of this observation are discussed. (GRA)

454 (AD/A-002478) STUDIES OF THE ACOUSTIC WAVES FORMED IN AN ELECTRIC DISCHARGE CO LASER CAVITY. Shen, P. I.; Griffin, W. S. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Nov 1974. Contract N00014-72-C-0043. 48p. (NRTC-74-58R). NTIS $3.75.

The work summarizes analytical and experimental studies of the compression and rarefaction waves which occur in a pulsed CO electric discharge laser cavity. The one-dimensional, acoustical analysis includes localized heating around the cathode, heat transfer to the cathode, flow through both the cathode and anode, and bulk heating of the plasma. With the aid of the analysis, bulk heating rates of CO lasing mixtures were calculated for various temperatures and pressures. Results from experimental studies of a northrop pulsed CO laser were used. Heating rates are presented for Ar-CO, N_2-CO, and N_2. (GRA)

455 (AD/A-002666) INVESTIGATION OF THE ELECTRIC DISCHARGE EXCITED VIBRATIONAL ENERGY TRANSFER LASER. Final Technical Report, 1 March 1974-15 November 1974. Bronfin, B. R.; Hall, R. J.; Shirley, J. A.; Verdieck, J. F. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 31 Dec 1974. Contract DAAH01-74-C-0907. 49p. (UARL-N-911846-4). NTIS $3.75.

The objective of the investigation is the development of technology required for demonstration of laser action in hydrogen halides pumped by vibrational energy transfer from hydrogen or deuterium excited in a low-pressure self-sustained electric discharge. A combined theoretical and experimental investigation of such a device relying upon near-resonant v-v transfer in the D_2-HCl pair has been undertaken. The theoretical analysis has treated the electric discharge excitation process, using a Boltzmann analysis of known and reliable electron excitation cross section data for processes occurring within the deuterium discharge. Mixing and vibrationally excited D_2 and HCl have been treated in a comprehensive one-dimensional kinetic model of an interacting gas dynamic flow of multi-vibrational level species. Experimental investigations have demonstrated direct evidence for effective vibrational energy 2000°K have been measured in HCl pumped by v-v transfer from discharged D_2 from an analysis of spontaneous infrared emission from the active medium. (GRA)

456 (AD/A-002692) LASER CALORIMETER. Durran, D. A. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Dec 1974. Contract F04701-74-C-0075. 41p. (SAMSO-TR-74-252). NTIS $3.75.

The measurement of high-power, cw laser performance has been facilitated by a closed-cavity calorimetry technique. A particular system developed for this application is described. Detailed drawings and operating procedures are given for its construction and use. (GRA).

457 (AD/A-002693) DISTRIBUTION FEEDBACK GaAs HOMOJUNCTION INJECTION LASER. Stoll, H. M.; Seib, D. H. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Dec 1974. Contract F04701-74-C-0075. 13p. (SAMSO-TR-74-249). NTIS $3.25.

The first observation of distributed feedback lasing in a pulsed homojunction GaAs injection laser is reported. Feedback was achieved via a third order grating structure which was ion machined in the top surface of the p-type layer. Laser action was observed at 8420 Å and 8459 Å corresponding to grating periodicities of 3548 Å and 3572 Å, respectively. Threshold current densities at 77°K were observed to be as low as approximately 5700 A/cm^2. (GRA)

458 (AD/A-002747) ATMOSPHERIC PRESSURE GAS LASERS. Mode Locking of High-Pressure CO^2 Lasers. Semiannual Technical Report, 1 June-30 November 1974. Haus, H. A. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1974. 25p. NTIS $3.25.

Mode-locked oscillation is a major bottleneck in the generation of short, high-power laser pulses, for application in laser fusion, communications, or radar. The objective has been to attain a comprehensive understanding of the mode locking of lasers with specific application to high-pressure CO_2 tea lasers. Toward this end work has proceeded along both theoretical and experimental lines. A new theoretical approach was developed, applicable to both active and passive mode locking. Experiments on high-pressure CO_2 lasers are in progress to substantiate the theoretical predictions. Results are summarized. (GRA)

459 (AD/A-002955) GAMMA-RAY LASERS (GRASERS). A Status Report. Cohen, L. (Naval Research Lab., Washington, D. C. (USA)). Dec 1974. 32p. (NRL-MR-2947). NTIS $3.75.

The concept of the graser (or gamma-ray laser) is discussed, and recent Russian and American proposals are surveyed. The difficulties in building a gamma-ray laser are outlined; and specific recommendations are made for delimiting the extent of NRL involvement in graser research in the near future. (GRA)

460 (AD/A-003047) RESEARCH STUDIES ON LASER HARMONIC GENERATION. Annual Report. (Stanford Univ., Calif. (USA). Microwave Lab.). Dec 1974. 38p. (ML-2382). NTIS $3.75.

The objective of work on this program is to develop techniques for the generation of coherent vacuum ultraviolet and soft x-ray radiation. The following topics are discussed: nonlinear optical processes by Van Der Waals interaction during collision; vacuum ultraviolet holography; generation of tunable picosecond vuv radiation; harmonic generation at high field strength, frequency shifts and saturation phenomena; conversion efficiency of harmonic generation processes in the presence of frequency shifts. (GRA)

461 (AD/A-003393) ir WINDOW STUDIES. Quarterly Technical Report No. 8. Kroger, F. A.; Marburger, J. H. (University of Southern California, Los Angeles (USA). Electronic Sciences Lab.). 15 Jun 1974. Contract F19628-72-C-0275. 102p. (USCEE-476; AFCRL-TR-74-0441). NTIS $5.25.

Topics discussed include: epitaxial growth of semi-insulating GaAs from Ga solutions; optimization of alkali halide window materials; fabrication of polycrystalline ir window materials; mechanical behavior and dielectric constant measurements; study of defects in CdTe; theoretical studies of absorption mechanism in ir window materials; wavelength and temperature dependent calorimetry measurements on GaAs; alkali halide (KCl) surface studies with acoustic probe techniques; absorption studies of CdTe and ZnSe; characterization of optical performance of ir window systems; and initial investigation of the role of inclusion damage in the failure of 10.6 micrometer optics. (GRA)

462 (AD/A-003397) OPTICAL PROPERTIES OF INFRARED TRANSMITTING MATERIALS (LQ-10 HIGH POWER LASER WINDOW PROGRAM). Bendow, B. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). Aug 1973. 38p. (CONF-730865-1; AFCRL-TR-74-0576). NTIS $3.75.

From conference on preparation and properties of electronic materials; Las Vegas, Nevada, USA (26 Aug 1973).

The choice of appropriate infrared transmitting materials for high-power laser applications necessitates a knowledge of various optical parameters. It has become important to be able to predict optical parameters from either theoretical or phenomenological models. Considerable progress has been made recently, especially with regard to the frequency dependence of refraction, absorption alpha and photoelasticity. It has been found, for example, that frequency dispersion is important at 10.6 micrometers for all three of the latter quantities in most alkali-halides. For most semiconductors, on the other hand, only the effects on alpha are significant. The mix of existing experimental data with recent theory is now providing a view of the magnitude, frequency dependence, and temperature dependence of optical parameters of infrared transmitting materials. (GRA)

463 (COM-74-11661) COMPILATION OF ELECTRON COLLISION CROSS SECTION DATA FOR MODELING GAS DISCHARGE LASERS. Kieffer, L. J. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). 30 Sep 1973. 151p. (JILA-IC-13). NTIS $6.25.

The compilation was prepared for use in modeling gas discharge lasers. Data are included on rare gases, alkali metals, Hg, N, O, H_2, CO, O_2, H_2O, and CO_2. Events described include total scattering, elastic scattering, momentum transfer, ionization, excitation, dissociation, and fluorescence. (GRA)

464 (COM-75-50003) LASER INDUCED DAMAGE IN OPTICAL MATERIALS: 1974. Annual Report (Final). Glass, A. J.; Guenther, A. H. (National Bureau of Standards, Boulder, Colo. (USA)). Dec 1974. 258p. (CONF-740524-6). GPO.

From ASTM Workshop; Boulder, Colorado, USA (22 May 1974).

The symposium heard 31 papers on topics relating to laser induced damage in crystalline and non-linear optical materials, at dielectric surfaces, and in thin film coatings as well as discussions of damage problems in the infrared region due both to cw and pulsed irradiation. In addition, several reports on the theoretical analysis of laser-materials interaction relative to the damage process were given, along with tabulations of fundamental materials properties of importance in evaluation of optical material response to high power laser radiation. Attention was given to high power laser system design considerations which relate to improved system performance and reliability when various damage mechanisms are operable in such systems. Because of the growing importance and acceptance of machined components in high power laser systems, a workshop on the machining of optics was held. Nine papers on various facets of the topic were presented dealing with machining procedures, surface characterization of machined elements, coating of machined components, and the polishing and damage resistance of polished, coated, and bare metal reflectors. Abstractors on these papers are included in the symposium proceedings. (GRA)

465 (UCID-16733) DESIGN STUDY OF HIGH AVERAGE POWER (20-100 WATTS) PULSED NITROGEN LASERS AT LAMBDA EQUALS 3371 A. Dzakowic, G.; Kan, T.; Kuenning, R.; Schlitt, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1975. Contract W-7404-Eng-48. 131p. Dep. NTIS $9.75.

The purpose of this design study is to assess the feasibility of building high average power nitrogen lasers with a goal of identifying data which must be obtained and technology which must be developed for the venture to succeed. The report consists of four sections which treats respectively; (1) laser modeling, (2) mode-control and energy extraction, (3) electrical pulser technology, and (4) gas flow. The conclusion reached is that the feasibility of high average power nitrogen lasers is very positive. Conceptual designs for 20 and 100 W nitrogen lasers are presented in (5). (auth)

466 (UCRL-76530) X-RAY AND GAMMA-RAY LASERS. Chapline, G.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1975. 13p. (CONF-750110-5). Dep. NTIS $4.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

The feasibility of producing x-ray and gamma-ray lasers is discussed. (TFD)

467 TIME CHARACTERISTICS OF GaAs SEMICONDUCTOR LASERS AT NEAR-THRESHOLD CURRENTS. Kobak, I. A.; Manak, I. S.; Popov, Yu. V.; Shilov, A. F. (Lenin State Univ., Minsk). Sov. Phys.-Semicond. (Engl. Transl.); 7: No. 11, 1384-1385(May 1974).

Translated from Fiz. Tekh. Poluprov.; No. 11, 2070-2073(Nov 1973).

Experiments have been performed to determine the radiative lifetime of minority carriers in a GaAs laser at currents near the threshold value. Lifetime changes were measured by using an FEU-28 photomultiplier and employing a phase technique at a modulation frequency of 930 MHz. For a current of twice the threshold value, a transition from spontaneous to stimulated emission caused the lifetime to be reduced by $\sim 1.5 \times 10^{-10}$ sec. The effective lifetime in the stimulated emission region was measured as $(1.3 \text{ to } 3.0) \times 10^{-11}$ sec. (Elect. Electron. Abstr.)

468 STABILIZATION OF WAVELENGTHS FROM GAS LASERS. Baird, K. M.; Hanes, G. R. (National Research Council, Ottawa). Rep. Progr. Phys.; 37: No. 7, 927-950(1974).

Various aspects of the problem of stabilizing the wavelengths of gas lasers are reviewed. Early techniques as well as the recent methods using saturated absorption that promise an accuracy of $1:10^{12}$ or better and which thereby may rival the precision of microwave frequency standards are described. (75 refs.) (Elect. Electron. Abstr.)

469 TWO-PHOTON RESONANT OPTICAL THIRD-HARMONIC GENERATION IN CESIUM VAPOR. Leung, K. M. (Univ. of Michigan, Ann Arbor); Ward, J. F.; Orr, B. J. Phys. Rev., A; 9: No. 6, 2440-2448(Jun 1974).

Resonant optical third-harmonics have been observed in Cs vapour, when twice the photon energy is equal to the energy difference of the ground and $9d^2D_{3/2}$ states. A tunable ruby laser was used at 148K. The measured third harmonic coefficient is about 10^2 times that for rubidium and 10^8 times larger than for helium. The calculated value assuming a single Cs atom at rest and allowing for Doppler broadening and the effect of the laser spectrum is in satisfactory agreement with the observed one. (Elect. Electron. Abstr.)

470 TOWARDS GAMMA-RAY LASERS. Wood, L.; Chapline, G. (Univ. of California, Livermore). Nature (London); 252: No. 5483, 447-450(6 Dec 1974).

It is suggested that two types of γ-ray lasers are possible: a gently pumped variety utilizing isomer separation and the Mossbauer effect, and one vigorously pumped using fast neutron excitation of compressed matter. (auth)

471 FREQUENCY SPLITTING OF THE OPPOSITELY TRAVELLING WAVES IN A RING LASER WITH A GAUSSIAN DIAPHRAGM. Boitsov, V. F.; Murina, T. A.; Fradkin, E. E. Opt. Spectrosc. (USSR) (Engl. Transl.); 36: No. 3, 311-314(Mar 1974).

Translated from Opt. Spectrosk.; 36: No. 3, 539-545(Mar 1974).

The behavior of the travelling wave amplitude inside the nonlinear medium is established. Nonlinear shifts and splitting of frequencies are calculated as a function of the width of the diaphragm, other geometrical considerations, and the complex nonlinear polarizability of the active medium. (Elect. Electron. Abstr.)

472 RADIATION OF LASERS WITH CONTROLLABLE PHOTOTROPIC SHUTTERS. Vinokurov, G. N.; Terentev, V. E. Opt. Spectrosc. (USSR) (Engl. Transl.); 36: No. 2, 229-232(Feb 1974).

Translated from Opt. Spectrosk.; 36: No. 2, 398-404(Feb 1974).

Optimum control modes for determining the possibility of raising lasing energy at a given pump energy are studied theoretically for a ruby laser. Computed curves of lasing intensity as a function of time for different delays of pump-to-loss-pulse are shown. Curves η^* the ratio of energy in a single pulse to maximum inversion energy (without lasing) versus threshold energy due to phototropic shutter, and versus pump energy with ultrasonic excitation in the phototropic medium are presented. Maximum increase in energy with ultrasound control over plain phototropic shutter is 1.3. Computed results agree with experiment. (Elect. Electron. Abstr.)

473 EFFECTS OF THE INSERTION OF A CW, LOW-PRESSURE CO_2 LASER INTO A TEA CO_2 LASER CAVITY. Girard, A. (Gen-Tec Inc., Dalton, Que.). Opt. Commun.; 11: No. 4, 346-351(Aug 1974).

The single mode performance of a cw-TEA (double discharge) CO_2 hybrid laser is reported. Single longitudinal and single transverse mode emission have been obtained in the short laser pulse regime (200 mJ, 150 ns fwhm) and in the long laser pulse regime (70 mJ, 2.5 μsec fwhm) on at least 30 lines of both the 10.6 μm and 9.6 μm bands in a far field, diffraction limited, half angle of divergence of 1.11 mrad. (Elect. Electron. Abstr.)

474 PARAMETRIC STUDY OF A uv PREIONIZED CO_2 LASER. Figueira, J. F. (Los Alamos Scientific Lab., NM). Opt. Commun.; 11: No. 3, 220-224(Jul 1974).

Small signal gain measurements of a uv preionized TWA CO_2 laser system are described. It is shown that the relative timing of preionization with respect to the main discharge determines the amount of electrical energy that can be deposited in the gas prior to arc formation. (Elect. Electron. Abstr.)

475 ELECTROMAGNETIC THEORY OF INJECTION LASER RADIATION. Osinski, M. (Academy of Science, Warsaw). Rozpr. Elektrotech.; 20: No. 2, 331-358(1974). (In Polish).

The article reviews the results that have been obtained by treating the semiconductor p-n junction laser as a waveguide. In the simplest case this waveguide consists of several layers of different complex dielectric constant values. The active layer, characterized by negative conductivity, is bounded by passive layers with positive conductivity. The refraction coefficient of the active layer is greater than those of passive layers, so the waveguide effect arises. By solving the wave equation for such a waveguide, one can obtain the electromagnetic field inside the laser. This enables one to estimate correctly the spectra of emitted radiation and also near- and far-field patterns. (Elect. Electron. Abstr.)

476 PASSIVE Q-SWITCHING OF THE RUBY LASER WITH ADDITIVELY COLORED CaF_2:La CRYSTALS. Hultzsch, R. Phys. Status Solidi (a); 23: No. 2, K117-K121(16 Jun 1974).

Switching experiments were performed using a CaF_2:La crystal within the laser resonator. Giant pulses are generated by centers absorbing at 650 nm. Power limitation is due to linear losses. Mechanisms are suggested for the peaks in the absorption spectrum in relation to Q-switching. (Elect. Electron. Abstr.)

477 STABLE cw HCN LASER. Yoshihiro, K.; Yamanouchi, C. (Electrotechnical Lab., Tokyo). Rev. Sci. Instrum.; 45: No. 6, 767-768(Jun 1974).

Simple techniques were developed to give stable outputs of 337 and 311 mu cw radiation with a conventional HCN laser over several to ten h. By use of a gas mixture of 1:1:2 by volume of CH_4, N_2 and He as the flowing gas, the rate of polymer crust deposition was reduced compared with CH_3CN or CH_4 and N_2 gas. The gas pressure was stabilized to 0.01 torr at 1.6 torr and a flowrate of 6 to 8 torr 1/min. The cathode was not grounded, but negatively charged at 10 percent dc source voltage. Output power stability achieved was +-2 percent without returning, over 10 h periods. (Elect. Electron. Abstr.)

478 PULSED-DISCHARGE INFRARED OH LASER. Wauchop, T. S.; Schiff, H. I.; Welge, K. H. (York Univ., Downsview, Ont.). Rev. Sci. Instrum.; 45: No. 5, 653-655(May 1974).

Infrared stimulated emission of vibrationally excited OH was produced by a pulsed electrical discharge through O_3–H_2 mixture. The discharge OH laser system was studied using the transverse two-electrode as well as a transverse multipin-electrode arrangement. The relative intensity of the stimulated emission at different wavelengths was investigated as a function of O_3 and H_2 pressures, the addition of foreign gases and discharge energy. The output of the multipin system was twice that of the two electrode system (at the same discharge energy). The output intensity was found to be similar to that produced in a H_2–SF_6 discharge in the multipin system, but with two orders down on power. (Elect. Electron. Abstr.)

479 DUAL CHANNEL NITROGEN LASER USEFUL FOR NANOSECOND EXCITED STATE STUDIES. Stephenson, P. B.; McDowell, V. P. (Louisiana Tech. Univ., Ruston). Rev. Sci. Instrum.; 45: No. 3, 427-428(Mar 1974).

Shipman (1967) adapted the Blumlein discharge circuit to lasers and this method has proved highly useful in producing high peak pulses. The authors describe a double Blumlein producing two 250 kW pulses separated by 15 nanosecs. The dual channel nitrogen laser is designed for use in atomic spectroscopy, the first pulse excites the target atoms while the second pumps another laser whose output is used to study the levels. (Elect. Electron. Abstr.)

480 CHARGE STORAGE IN INJECTION LASERS AND ITS EFFECT ON HIGH-SPEED PULSE MODULATION OF LASER DIODE. Lee, T. P.; Derosier, R. M. (Bell Telephone Labs., Inc., Holmdel, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 62: No. 8, 1176-1177(Aug 1974).

Charge storage in injection lasers under transient forward bias has been found to be responsible for the difference in the observed threshold for a driving current pulse with and without another pulse preceding it. Estimated relative threshold currents of two successive pulses as a function of pulse spacing based on the charge storage model agreed reasonably well with the experiment. (Elect. Electron. Abstr.)

481 MOLECULAR-HYDROGEN LASER: 1098 TO 1613 A. Dreyfus, R. W.; Hodgson, R. T. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). Phys. Rev., A; 9: No. 6, 2635-2648(Jan 1974).

Amplified spontaneous emission in hydrogen isotopes has been excited by a 4-GW electron beam. Photodiodes, an ionization chamber and film are used in the measurement of the laser energy. Detailed comparison of the different measurements suggests that Doppler broadening is responsible for the spectral linewidth; thus, higher gain and power are produced on cooling the gas. This gain means lasing may be observed at shorter wavelengths than before. Spectral lines of the Werner and Lyman bands can be identified. The Doppler-broadening hypothesis is checked by using deuterium in the laser. (Elect. Electron. Abstr.)

482 CONSTRUCTION OF A HIGH POWER XENON ION LASER. Harper, C. D.; Gundersen, M. (Univ. of Southern California, Los Angeles). Rev. Sci. Instrum.; 45: No. 3, 400-402 (Mar 1974).

The laser, which produces 9 mJ per pulse at 10 pulses per sec has a peak power of 82 kW. Circuit and design details are provided. (Elect. Electron. Abstr.)

483 CALCULATION OF THE POWER OF A CO_2 GAS-DYNAMIC LASER. Napartovich, A. P.; Sharkov, V. F. (Inst. of Atomic Energy, Moscow). High Temp. (USSR) (Engl. Transl.); 12: No. 3, 570-571(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 659-661 (1974).

A previously developed model, with some additional simplifications and allowance for stimulated transitions, was used to optimize laser power with respect to mirror transmissivity. The resulting qualitative laws are consistent with experimental results. (PMA)

484 RELATIVISTIC ANGULAR MOMENTUM OF POWER CIRCULATION. Herold, U. K. Nature (London); 252: No. 5485, 674-675(20 Dec 1974).

It is shown that a special relativistic turning effect results from the angular momentum of mass circulation associated with closed circuit mechanical or electromagnetic power transmission. As a result of the relativistic equivalence of energy and mass the momentum density of a body through which power is transmitted is a function of the power flowing through it. This is interpreted in terms of relativity. Examples are given, including application to a closed superconducting circuit. It is stated that the most intense power circulation achieved so far is in a high power ring laser, such as the CO_2 laser at Los Alamos. A laser pulse of 10^4J circulating in a path of radius 3m has an angular momentum of 10^3g cm^2 s^{-1}. (UK)

485 REPORTS ON PROGRESS IN PHYSICS. Volume 37, Part 3, 1974. Ziman, J. M. Portland, OR; International Scholarly Book Services, Inc. (1974). 400p. $27.50.

A separate abstract has been prepared for one of the five articles. Two articles were previously abstracted in NSA and appear as abstracts 31: 09741 and 31: 10347. The remaining articles were not in scope for NSA. (TFD)

For an abstract of an individual paper see: 486.

486 STABILIZATION OF WAVELENGTHS FROM GAS LASERS. Baird, K. M.; Hanes, G. R. (National Research Council of Canada, Ottawa). Rep. Progr. Phys.; 37: 927-950 (1974).

The article reviews various aspects of the problem of stabilizing the wavelengths of gas lasers. It describes early techniques as well as the recent methods using saturated absorption that promise an accuracy of 1:10^{12} or better and which thereby may rival the precision of microwave frequency standards. (auth)

487 CHEMICAL LASERS. II. Warren, W. R. Jr. (Aerospace Corp., El Segundo, CA). Astronaut. Aeronaut.; 13: No. 4, 36-49(Apr 1975).

The article primarily treats vibrational transition lasers, but also briefly covers the potential for electronic transition lasers. (TFD)

488 EFFECT OF KINETIC RATE UNCERTAINTIES ON GASDYNAMIC LASER GAIN AND ENERGY PREDICTIONS. Anderson, J. D. Jr. (Univ. of Maryland, College Park). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 12, 1699-1703 (Dec 1974).

Using an existing computer code, a study is made of the sensitivity of gasdynamic laser calculations to uncertainties in the vibrational energy exchange rates associated with CO_2-N_2-H_2O gas mixtures. The results show that calculations of gasdynamic laser gain and maximum available energy in the laser cavity can be subject to noticeable inaccuracy due to rate data uncertainties. Moreover, those rates to which the calculations are most sensitive are clearly delineated. (auth)

489 MASS SPECTROSCOPY OF THE PLASMA OF CW AND TEA CO_2 LASER DISCHARGES. Schotzau, H. J.; Conti, F.; Gindrat, R.; Kneubuhl, F. K. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett.; 48A: No. 3, 205-206(17 Jun 1974).

The composition of the plasmas in cw- and TEA-CO_2 laser discharges was analyzed with a quadrupole mass spectrometer. Small concentrations of discharge-generated nitrogen oxides already known to be present in the cw-CO_2 laser plasmas have also been found in the TEA-CO_2 laser plasmas. (Elect. Electron. Abstr.)

490 QUANTUM STATISTICS OF A MONOMODE-LASER MODEL. Walgraef, D. (Univ. Libre, Brussels). Physica; 72: No. 2, 578-596(1974).

A kinetic equation for the photon density matrix of a monomode laser model with explicit heat baths is derived in the framework of the Prigogine-Resibois theory of nonequilibrium statistical mechanics. Approximate solutions are discussed and are found to agree with other theories. The phase transition behavior and the creation of order which is due to the nonlinear structure of the macroscopic kinetic equations may be interpreted within the most recent theories of far-from-thermal-equilibrium open systems while further study is needed to fill completely the gap between microscopic and macroscopic description. (Elect. Electron. Abstr.)

491 LASER AMPLIFIER DESIGN. Goldstein, J. C. (Los Alamos Scientific Lab., NM). Opt. Commun.; 11: No. 2, 118-122 (Jun 1974).

Often one wants a laser amplifier system to produce an output pulse of a specific form, e.g., time shape, energy, etc. Given any potential amplifier configuration one needs to find the proper

input pulse which, when propagated through the amplifier system, results in the desired output pulse. Efficient operation of the amplifier (large energy extraction) usually implies that the response of the laser medium is nonlinear, which makes such a calculation very tedious if attempted on a hit and miss basis. A procedure is discussed which enables one to systematically generate the proper input pulse. Once the input is known it is straightforward to determine whether the amplifier configuration is suitable. (Elec. Electron. Abstr.)

492 OPTICAL COUPLING OF TWO DIODE LASERS WITH VARIABLE COUPLING COEFFICIENT. Salathe, R.; Voumard, C.; Weber, H. (Univ., Bern). Phys. Status Solidi (a); 23: No. 2, 675-682(16 Jun 1974).

Two diode lasers have been coupled by means of conventional optics. The coupling coefficient has been altered by inserting additional filters into the light path between the two diodes. The power output and the spectral behavior of both diodes have been investigated as a function of the coupling coefficient. The power output measurements are compared with theoretical calculations based on a rate equation approach. The spectral measurement at the different coupling steps reveals that both diodes emit the same spectra. The spectral width of the emission increases with an increasing coupling coefficient. (Elect. Electron. Abstr.)

493 EFFECT OF AN AXIAL MAGNETIC FIELD ON THE BEAT FREQUENCY IN A SYNCHRONIZED HELIUM-NEON RING LASER REGIME. Galkin, S. L.; Nikolaev, V. M.; Okunev, R. I.; Petrun'kin, V. Yu. (Leningrad Polytechnical Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 9, 1257-1258(Mar 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 9, 1995-1998(Sep 1973).

The ring laser has a triangular resonator with a perimeter of 185 cm. Two He-Ne discharge tubes with solenoids are used. For synchronization of the longitudinal modes the axial magnetic field significantly reduces the effect of detuning the modulation signal and amplitude modulation on the beat frequency. (Elect. Electron. Abstr.)

494 OUTPUT POWER METER FOR IR LASERS. Lushchikov, I. I.; Mamakina, S. V.; Mansvetov, N. G.; Prokof'eva, T. D. Sov. J. Opt. Technol.; 40: No. 8, 489-491(Aug 1973).

Translated from Opt.-Mekh. Prom.; 40: No. 8, 27-29(Aug 1973).

The optics, of a system which balances the power against radiation from a standard blackbody source, are shown diagrammatically and the principal optical and electrical elements are described. Infrared radiation power in beams up to 30 mm dia. including distribution over cross-section with an accuracy of better than 1% is achieved over the range 10^{-6} to 100 W in the wavelength band 0.2 to 12 μm with a maximum time constant of 1 sec. (Elect. Electron. Abstr.)

495 DEPOLARIZATION OF THE RADIATION OF GIANT-PULSE NEODYMIUM-GLASS LASERS. Kryzhanovskii, V. I.; Serebryakov, V. A.; Starikov, A. D. Sov. J. Opt. Technol.; 40: No. 8, 478-479(Aug 1973).

Translated from Opt.-Mekh. Prom.; 40: No. 8, 14-15(Aug 1973).

The experimental method of measurement of the effect is described. Oscillograms of depolarization of gas lasers in an amplifier for various conditions are presented. Dependence of radiation depolarization on amplifier pump energy in the range 8 to 20 kJ with and without "compensating flash" is plotted. Normalized distribution of depolarization is plotted as a function of direction in a 4-lamp illuminated amplifier. Results are discussed and it is concluded that rods with minimal thermo-optic birefringence should be used to minimize amplifier loss. (Elect. Electron. Abstr.)

496 STRESS-TUNED STIMULATED LIGHT SCATTERING IN P-TYPE SEMICONDUCTORS. Yuen, S. Y. (Massachusetts Inst. of Tech., Cambridge); Lax, B.; Wolff, P. A. Solid State Commun.; 14: No. 11, 1079-1082(1 Jun 1974).

A new mechanism for generating tunable high power coherent radiation in the wavelength range 10μ to 25μ from a single laser system is proposed. The proposed device is based on stimulated light scattering continuously tuned by stress in p-type semiconductors. The conditions and feasibility for such Raman laser operation are discussed in detail. (Elect. Electron. Abstr.)

497 CHEMICAL LASERS. Tsuchiya, S.; Inoue, H. (Tokyo Univ.). Oyo Butsuri; 43: No. 1, 2-17(Jan 1974). (In Japanese).

The characteristics of chemical lasers are reviewed in terms of the chemical pumping reaction and the collisional relaxation processes. The reported values of chemical reaction rate specific to each vibrational level of product molecules are summarized, and the principle of the product excitation is discussed. Also, the mechanism of V-R, T and V-V relaxations is explained briefly using collision dynamics. The computer simulation of HF lasing system is made through the coupled differential equations of kinetics including the pumping reaction, the V-R, T and V-V relaxations, and the stimulated transitions. (Elect. Electron. Abstr.)

498 STABILITY BOUNDARIES OF TWO-MODE LASERS IN THE STRONG-COUPLING LIMIT. Texter, J. A. (Lehigh Univ., Bethlehem, PA). Phys. Rev., A; 9: No. 6, 2649-2651(Jun 1974).

Necessary and sufficient conditions are derived for the field fluctuations causing a bistable two-mode laser to mode-hop. The analysis derives from the differential equations of Lyapunov's theory of stability of motion. Numerically generated results for a particular two-mode bistable system are given, with a discussion of possible extensions of the theory to more refined two-mode and multimode cases. (Elect. Electron. Abstr.)

499 SELECTION OF cw MODE-LOCKED LASER PULSES. Corcoran, V.J.; McMillan, R.W.; Rushworth, P.M. (Martin Marietta Aerospace, Orlando, Florida 32805). Appl. Opt. 14: No. 3, 643-646 (Mar 1975).

A compact device capable of selecting pulses from a cw mode-locked pulse train is described. A single pulse, a repetitive train of pulses, or a random pulse may be selected. Tests results are given. (auth)

500 PRECISION BEAM SPLITTERS FOR CO_2 LASERS. Franzen, D.L. (Quantum Electronics Division, National Bureau of Standards, Boulder, Colorado 80302). Appl. Opt. 14: No. 3, 647-652(Mar 1975).

Beam splitters for 10-μm lasers are discussed and then applied to the precision measurement of high average powers. In particular, beam splitter stability has been investigated in various materials over the 20-600-W power range with power densities up to 1 kW/cm^2. The absolute beam splitter ratios are given along with the achieved measurement precisions. The semiconductors investigated were GaAs, CdTe, and ZnSe in addition to one alkali-halide KCl. Standard deviations for the beam splitter ratios of 1% over the power range were typical. Absolute ratios agree with the predictions from Fresnel's equations to 1% or better. The best measurement was made on ZnSe when a standard deviation of 0.4% was obtained for the measurement of a ratio that agreed with a calculation from Fresnel's equations to better than 0.5%. (auth)

501 HIGH-EFFICIENCY MULTIPLY PULSED COPPER VAPOR LASER UTILIZING COPPER CHLORIDE AS A LASANT. Chen, C.J.; Russell, G.R. (Jet Propulsion Laboratory, Pasadena, California 91103). Appl. Phys. Lett. 26: No. 9, 504-505 (1 May 1975).

A copper vapor laser operating at a wavelength of 5106 Å and a pulse repetition rate up to 30 000 pulses/sec has been constructed and investigated. The best results obtained to date are as follows: energy and power density of 35 μJ cm^{-3} and 1.7 kW cm^{-3}; pulsewidth 20 nsec; average density 0.7 W cm^{-3}; laser efficiency 1%. (auth)

502 TRANSVERSE SELF-SUSTAINED DISCHARGE CO_2 LASER. Cohn, D.B. (Northrop Corporation, Northrop Research and Technology Center, Hawthorne, California 90250). Appl. Phys. Lett. 26: No. 9, 508-509 (1 May 1975).

A scalable transverse self-sustained discharge maintained between an array of flow-stabilized cathodes and a common anode has demonstrated specific input powers of 800 W/g/sec and power densities of 100 W/cm^3 per cathode for CO_2-N_2-He mixtures at pressures of 50-70 Torr. Optical extraction at 15% efficiency has been obtained under nonoptimized conditions in a geometry with the parallel fluid flow and discharge electric field perpendicular to the optical axis. (auth)

503 QUASI-cw LASER EMISSION FROM THE SECOND POSITIVE BAND OF NITROGEN. Suchard, S.N.; Galvan, L.; Sutton, D.G. (The Aerospace Corporation, El Segundo, California 90245). Appl. Phys. Lett. 26: No. 9, 521-523 (1 May 1975).

Experimental results are presented for the observation of a second positive nitrogen laser that has a pulse length much longer than the radiative lifetime of the upper laser level. Preliminary measurements of the temporal behavior of this laser indicate that it was operating in a quasi-continuous-wave manner and, in addition, the laser output was extremely sensitive to the alignment of the optical cavity placed around the discharge tube. (auth)

504 GAIN SPECTRUM OF A HIGH-PRESSURE CO_2 LASER. Miller, J.L.; Ross, A.H.M.; George, E.V. (Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 26: No. 9, 523-526 (1 May 1975).

The gain spectrum of a high-pressure uv preionized CO_2 laser was measured for pressures to 14 atm. The data show an ~10% increase in the gain of the P branch of the 961-cm^{-1} (00^01) - $(10^00)_I$ band which is attributed to the overlapping 927-cm^{-1} 01^11- $(11^10)_I$ band. The measured gain was shown to be in good agreement with the theoretical predictions of a four-temperature kinetic model. (auth)

505 ROOM-TEMPERATURE HETEROJUNCTION LASER DIODES OF $In_xGa_{1-x}As/In_yGa_{1-y}P$ WITH EMISSION WAVELENGTH BETWEEN 0.9 AND 1.15 μM. Nuese, C.J.; Olsen, G.H. (RCA Laboratories, Princeton, New Jersey 08540). Appl. Phys. Lett. 26: No. 9, 528-531 (1 May 1975).

Vapor-grown *p-n* heterojunction laser structures of $In_xGa_{1-x}As/In_yGa_{1-y}P$ have been prepared with laser threshold current densities as low as 15 000 A/cm² at room temperature and 1000 A/cm² at 77 °K. Emission wavelengths between 1.025 and 1.15 μm have been obtained at 300 °K. (auth)

506 EXCITATION MECHANISM OF THE He-I^+ LASER. Shay, T.; Kano, H.; Collins, G.J. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523). Appl. Phys. Lett. 26: No. 9, 531-534 (1 May 1975).

We have investigated the afterglow decay rates of sixteen iodine ion, I(II), laser lines in spontaneous emissions. All lines originate from the four triplet terms of the $5s^25p^3(^2D^0)6p$ electronic configuration. The variation of the I(II) spontaneous emission decay rates with increasing iodine pressure provides direct evidence that a charge-transfer reaction involving the ground-state atomic helium ion and a ground-state iodine atom is a primary source of excitation for the upper levels of the helium-iodine ion laser. A total velocity-averaged cross section, σ (He^+-I), of 3×10^{-16} cm² has been measured. (auth)

507 TRANSIENT EFFECTS IN WAVELENGTH-MODULATED DYE LASERS. Tang, C.L.; Telle, J.M.; Ghizoni, C. (Cornell University, Ithaca, New York 14853). Appl. Phys. Lett. 26: No. 9, 534-537 (1 May 1975).

A new laser transientlike effect is observed in a wavelength-modulated cw dye laser. A theory for this effect is developed and shown to be in close agreement with the observed transients. (auth)

508 STRIATION MODULATION OF He–Ne LASER EMISSION. Zakharenko, Yu.G. Opt. Spectrosc. (USSR) 37: No. 5, 565-566 (Nov 1974).

Striation modulation of He–Ne laser radiation in a dual anode discharge tube is reported. The dependence of output power on discharge current for different diameters of the capillary discharge tube is also reported. (AIP)

509 USE OF DISPERSION PROPERTIES OF THE ACTIVE MEDIUM OF A LASER TO STABILIZE ITS EMISSION FREQUENCY. Kapralov, V.P.; Bulygin, A.S. Opt. Spectrosc. (USSR) 37: No. 5, 568-569 (Nov 1974).

Measurements are reported of the frequency instability of an He–Ne laser operating in a three–frequency regime. An automatic frequency tuning system is described for the output of type LQ–56 He–Ne laser. (AIP)

510 DRIFT OF EXCITED NEON ATOMS IN A DISCHARGE. Vinogradov, V.I.; Eletskii, A.V. Opt. Spectrosc. (USSR) 37: No. 5, 486-488 (Nov 1974).

The results of an investigation at wavelengths of 1.15 μm and 0.63 μm of drift processes in a dc neon discharge are presented. The values of the difference frequencies in a traveling–wave laser due to the drift of atoms as a result of the Langmuir effect and dissociative recombination of molecular ions of neon are obtained separately. The experimental results are in satisfactory agreement with theory. The drift velocity of neon atoms (the Langmuir effect) is found as a function of the pressure. (auth)

511 INVESTIGATION OF SEVERAL CHARACTERISTICS OF AN He–Cd LASER. Korolev, F.A.; Odintsov, A.I.; Feofilaktova, T.V.; Kalinovskaya, N.I. Opt. Spectrosc. (USSR) 37: No. 6, 669-670 (Dec 1974).

Measurements are reported on the saturated gain of 4416 Å line of He–Cd laser. (AIP). (auth)

512 NEW TREND IN LASER PHYSICS: OPTOTHERMODYNAMICS. Bunkin, F. V. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 302-305(Mar 1974). (In Russian).

Attention is drawn to the opportunity offered by the newly discovered ability to generate optical radiation with pulses of a time- and space-programmed form as regards the problem of transferring the microsystems interacting with the radiation from a given initial state to a given terminal state by a given transition path. (Elect. Electron. Abstr.)

513 LIMITING POWER CHARACTERISTICS OF PULSED TRANSVERSELY EXCITED ATMOSPHERIC (TEA) CO_2 LASERS. Orishich, A. M.; Ponomarenko, A. G.; Soloukhin, R. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 1, 3-12(1975). (In Russian).

This study presents the results of experimental measurements of the absorption of large amounts of specific electrical energy in a gas laser over a wide region of pressures (0.1 to 0.5 atm of CO_2: $2N_2$: 0.5 H_2 gas mixture). By measuring the current and voltage it was possible to determine the basic parameters characterizing the discharge, i.e., the resistance, power, and total adsorbed energy per unit volume. It was established that limitations ($E_0/p > 45$ v/cm-tor and $Q/p < 1$ joule/cm³-atm) exist that make possible the existence of a diffusion discharge. In this case it was possible to determine the relation between the limiting value of the electrical energy density which can be adsorbed in the discharge, the initial parameters of the system and the amount of emitted energy. (SJR)

514 OPTICAL METHOD FOR DETERMINATION OF THE THERMAL RESISTIVITY OF LASER DIODES. Meixner, H.; Unger, R. (Siemens AG, Munich). Siemens Forsch.-Entwicklungsber.; 3: No. 3, 190-194(1974). (In German).

An important parameter of a semiconductor laser operated in the cw mode is its thermal resistivity. The described optical technique is used to measure the thermal resistivity of laser diodes by means of a simple experiment. A heat flow model elucidates the theoretical calculation of thermal resistivity. Measured and calculated results are compared. In conclusion, dependences other than the temperature variation of the band gap are discussed. (Elect. Electron. Abstr.)

515 EFFECT OF PLASMA OSCILLATIONS ON EMISSION FROM AN ARGON LASER. Fotiadi, A. E.; Fridrikhov, S. A. (Leningrad Polytechnical Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 9, 1271-1272(Mar 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 9, 2010-2012(Sep 1973).

A short description of an experimental study in which the laser output, intensity, frequency of oscillation, and longitudinal potential gradient are measured, for a wide range of currents and pressures. The effect of a magnetic field is also investigated. Oscillations at 1.2 MHz significantly affect the laser output. (Elect. Electron. Abstr.)

516 THEORY OF A PLANE OPTICAL RESONATOR AND WAVEGUIDE WITH A SEMITRANSPARENT WALL. Pekar, V. S. Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1350-1358(Aug 1974). (In Russian).

An optical resonator and waveguide consisting of an infinite layer of dielectric covered with fully reflecting and semitransparent mirrors was calculated. The refractive indices of the mirrors are assumed to be purely imaginary in the zero approximation. In the first approximation the small real parts of the refractive indices of the mirrors are taken into account. For non damping in vacuum waves the ratio of the dielectric amplitude to the vacuum amplitude is determined as a function of frequency and ray direction. This ratio is important for the theory of radiation and scattering of light in resonators, in particular, in thin-film lasers. The quality (Q) of the ZnS-Mn electroluminescent laser working mode is calculated. Conditions under which stimulated radiation, as distinct from spontaneous emission, is fully polarized, are indicated. (Elect. Electron. Abstr.)

517 INVESTIGATION OF RUBY BREAKDOWN BY A TRAIN OF SINGLE ULTRASHORT PULSES. Baev, V. M.; Savchenko, A. N.; Sviridenkov, E. A. Zh. Eksp. Teor. Fiz.; 66: No. 3, 913-919(Mar 1974). (In Russian).

Breakdown of ruby by ultrashort laser pulses with a wavelength 1.06 μm was investigated. A cumulative effect which lowers the optical stability of the crystal was observed under the action of the train of pulses on the ruby. The dependence of the effect on the repetition interval of pulses in the train was investigated. It is shown that direct ionization of atoms of the crystal lattice in the field of a strong electromagnetic wave, but not impact cascade ionization, plays the decisive role in optical breakdown in ruby. (Elect. Electron. Abstr.)

518 MOLECULAR SATURATION AND THE CRITERION FOR PASSIVE Q SWITCHING. Oppenheim, U. P.; Kaufman, Y. J. (Israel Inst. of Tech., Haifa). IEEE J. Quant. Electron.; QE-10: No. 7, 533-540(Jul 1974).

Rotational hole burning is known to be the main factor that determines saturation in molecular absorbers during a short pulse. Experimental results are presented that suggest that pulse transmission measurements, as opposed to cw transmission measurements, must be used in order to determine if a gas can be used as a saturable absorber in passive Q switching. Rate equations are developed for a five-state model to explain saturation in SF_6. This model is found to predict cw and pulse transmission through SF_6 at various lines of the 10.4-mum band of the CO_2 laser. A simplified model is developed for pulse transmission through saturable gases and is solved analytically for the peak of the pulse. It is found that the absorption coefficient of the absorber at the peak of the pulse is given by a simple expression, which leads directly to a new criterion for passive Q switching. An experimental test of this criterion is carried out for several mixtures of SF_6 and He which act as saturable absorbers under varying conditions of irradiation. It is found that the transition from cw to pulsed operation is very sharp and occurs at a well-defined value of radiation intensity. (auth)

519 EMISSION CROSS SECTION AND FLUORESCENCE EFFICIENCY OF Nd-PENTAPHOSPHATE. Weber, H. P.; Liao, P. F.; Tofield, B. C. (Bell Labs., Holmdel, NJ). IEEE J. Quant. Electron.; QE-10: No. 7, 563-567(Jul 1974).

The room-temperature cross sections for the Nd^{3+} ^4F/sub 3/2/ levels to the ^4I/sub 11/2/ and ^4I/sub 9/2/ manifolds (lower laser state and ground state, respectively) in NdP_5O_{14} are measured by two spectroscopic methods. A value for the largest cross section of sigma(R_1–Y_2) equals 1.7×10^{-19} cm^2 is found. The highest effective cross section, resulting from superposition of two lines at 1.051 mum, gives a laser gain per Nd ion which is about 2/3 of the maximum gain in YAG:Nd. The relative branching ratio into the ^4I/sub 11/2/ and ^4I/sub 9/2/ manifolds is 0.65:0.35. Comparison of the integrated cross sections with the measured lifetime for 1-percent Nd in LaP_5O_{14} indicates a combined efficiency less than 0.1 for the remaining transitions, namely radiative decay into the ^4I/sub 13/2/ and ^4I/sub 15/2/ manifolds and multiphonon quenching. A measurement of temperature dependence of fluorescence lifetime supports this last result. (auth)

520 GaAs P-N-P-N LASER DIODE. Lockwood, H. F.; Etzold, K. F.; Stockton, T. E.; Marinelli, D. P. (RCA Labs., Princeton, NJ). IEEE J. Quant. Electron.; QE-10: No. 7, 567-569(Jul 1974).

The general structure of double-heterojunction diode lasers is shown to be consistent with the required geometry of the Shockley diode or p-n-p-n switch. When the two devices are combined in a single structure, there results an extremely simple source of high optical power (more than 0.5-W) pulses of very short duration (less than 10 ns) without the need for a complex external driver. In principle, pulse triggering and repetition rate are easily controlled, suggesting that the device has potential application in pulse-coded optical communication systems. (auth)

521 SUBNANOSECOND RISE TIME PULSES FROM INJECTION LASERS. Vanderwall, J.; Hattery, W. V.; Sztankay, Z. G. (Hary Diamond Labs., Washington, D. C.). IEEE J. Quant. Electron.; QE-10: No. 7, 570-572(Jul 1974).

The hybrid integration of an injection laser with a simple avalanche transistor modulator is shown to produce optical peak powers of several tens of watts magnitude and pulse rise times appreciably shorter than 1 ns. In certain circumstances the pulse leading edge assumes the form of a spike having a displayed rise time of 120 ps. (auth)

522 FREQUENCY STABILIZATION AND FINE-TUNING CHARACTERISTICS OF A CW InSb SPIN-FLIP LASER. Brueck, S. R.; Mooradian, A. (Massachusetts Inst. of Tech., Lexington). IEEE J. Quant. Electron.; QE-10: No. 9, 634-641(Sep 1974).

A study, using heterodyne techniques, of the magnetic field (1 to 10 kG), electron concentration (10^{14} to 10^{15} cm^{-3}), and alignment dependencies of the tuning characteristics of an InSb spin-flip laser pumped with a 5-mum CO laser is reported. These characteristics vary from a nearly continuously tunable broadband (100-MHz) output to quasi-continuous single-mode hopping and pulling with mode tuning rates varying from greater than 75 MHz/G to less than 30 MHz/G. Large variations in the tuning rate are observed within a single-mode tuning range of less than 1 GHz. The frequency and magnetic-field dependencies of the InSb index of refraction have been measured in the near-resonance regime and a simple theoretical fit to the dispersion data is carried out. A hybrid frequency and phase-lock closed-loop system to maintain the output frequency of the spin-flip laser at a variable frequency offset from the frequency of a CO local-oscillator laser has been constructed. This system results in three major improvements in the operating characteristics of the spin-flip laser: (1) the output frequency is accurately calibrated relative to the CO-laser frequency, (2) the tuning of the spin-flip laser can be controlled in a well-calibrated fashion by varying the frequency offset, and (3) the frequency jitter and stability of the spin-flip is reduced to less than or approximately 30 kHz. (auth)

523 DELAYS AND Q SWITCHING IN SEMICONDUCTOR LASERS: STILL AN OPEN QUESTION. Ripper, J. E.; Rossi, J. A. (Massachusetts Inst. of Tech., Lexington). IEEE J. Quant. Electron.; QE-10: No. 4, 435-441(Apr 1974).

A critical review is made of the available experimental data and the proposed theoretical explanations regarding long delays and Q switching in semiconductor lasers. It is shown that no model is completely satisfactory in explaining all the available data. Guidelines for developing a better theory are presented. (auth)

524 ELECTRONIC- AND PHONON-TERMINATED LASER EMISSION FROM Ho^{3+} IN BaY_2F_8. Johnson, L. F.; Guggenheim, H. J. (Bell Labs., Murray Hill, NJ). IEEE J. Quant. Electron.; QE-10: No. 4, 442-449(Apr 1974).

Infrared spontaneous and stimulated emission from Ho^{3+} in BaY_2F_8 is reported. In addition to the familiar $^5I_7$ yields $^5I_8$ transition at 2 mu, $^5F_5$ yields $^5I_5$ emission at 2.4 mu and $^5I_6$ yields $^5I_7$ emission at 2.9 mu are discussed. There are several unusual features of the 2-mu laser emission. At room temperature, phonon-terminated laser emission is observed at 2.171 mu. At 77°K a complex cw laser output is observed in a wavelength interval lying on the shoulder of a fluorescence line. The complex output is attributed to oscillation in transverse modes of the resonator. Oscillation is not observed in the strongest emission line, despite a large terminal state splitting of 310 cm^{-1}. These results are explained on the basis of a theory developed earlier for transition metal ion lasers. The validity of the model is supported by demonstrating the tunability through loss modulation predicted by theory. The observation of these effects is made possible by the very low internal scattering loss in the crystals. The $^5F_5$ yields $^5I_5$ laser lines near 2.4 mu represent relatively low gain transitions with pulse durations limited by accumulation in a longer lived terminal state. The dynamics of laser emission indicate the possible absence of thermal equilibrium in the excited state. For the 2.9-mu transition the bottleneck posed by a longer lived terminal state may be eliminated by the addition of Eu^{3+} or Pr^{3+}, but laser emission could not be obtained. (auth)

525 INDUCED-EMISSION CROSS SECTIONS IN NEODYMIUM LASER GLASSES. Krupke, W. F. (Univ. of California, Livermore). IEEE J. Quant. Electron.; QE-10: No. 4, 450-457(Apr 1974).

A method for calculating induced-emission cross sections in neodymium laser glasses, based on simple absorbance measurements, has been demonstrated. Absorption and emission transition probabilities of four silicate-base neodymium laser glasses have been characterized in terms of the Judd--Ofelt (JO) model of crystal-field-induced electric-dipole transitions. Absolute absorption intensities in 3669A, ED-2, LSG-91H, and S33 glasses were measured and used to determine three phenomenological intensity parameters for each glass which accounted for the measured intensities to within 5 percent (rms). Emission intensities between the metastable ^4F/sub 3/2/ and terminal ^4I J levels were then calculated for each glass, together with the ^4F/sub 3/2/ radiative lifetime, fluorescence branching ratios, and radiative quantum efficiency. Calculated values of these quantities for 3669A and S33 glasses are compared with measured values appearing in the literature. Using experimental line shapes for the ^4F/sub 3/2/ yields ^4I/sub 11/2/ transitions at 1.06 mu, induced-emission cross sections for these glasses were calculated. (auth)

526 ELECTRONIC TUNING OF A DYE LASER WITH SIMULTANEOUS MULTIPLE-WAVELENGTH OUTPUT. Hutcheson, L. D.; Hughes, R. S. (Michelson Labs., China Lake, CA). IEEE J. Quant. Electron.; QE-10: No. 4, 462-463(Apr 1974).

Rapid simultaneous multiple-wavelength tuning of a dye laser has been achieved electronically by inserting an acoustooptic beam deflector inside the laser cavity. A beam deflector and diffraction grating combination serve as the tuning element. By applying multiple-rf signals to the acoustooptic deflector, multiple-wavelength operation is readily obtained. (auth)

527 HIGH-PEAK-POWER 532-nm PUMPED DYE LASER. Ammann, E. O.; Decker, C. D.; Falk, J. (GTE Sylvania Inc., Mountain View, CA). IEEE J. Quant. Electron.; QE-10: No. 4, 463-465(Apr 1974).

A dye laser, pumped by the second harmonic of a flash-pumped Q-switched Nd : YAG oscillator/amplifier chain is described. The dye laser produces 8-ns-long pulses with energies as great as 140 mJ and peak powers of 20 MW. At a repetition rate of 10 pulses/s, the average power obtained is 1.4 W and the conversion efficiency (532 nm to dye) is approximately 50 percent. (auth)

528 IMMUNE MECHANISMS IN LEUKEMIA: EVALUATION OF IMMUNOCOMPETENT CELL POPULATIONS. Lukasewycz, O. A.; Martinez, D.; Murphy, W. H. (Univ. of Michigan, Ann Arbor). J. Immunol.; 114: No. 5, 1491-1496(May 1975).

Dose-response curves of the cellular immune response of C58/wm mice to syngeneic line I/sub b/ malignant lymphoid cells (I/sub b/ cells) were computer analyzed by the PROBT subroutine in the IBM Scientific Subroutine Package. An analysis of the relative immunogenicity of various admixtures of x-irradiated (XI/sub b/) and viable I/sub b/ cells (VI/sub b/) after i.p. injection showed that the ratio had to be approximately 100 : 1 to be immunogenic. Viable I/sub b/ cells contained in immunogenic mixtures multiplied in vivo at a logarithmic rate up to 5 or 6 days but were eliminated immunologically by 8 or 9 days. Adoptive cell transfer techniques were used to quantify the protective effect of immune spleen cells (ISC). Essentially a constant dose of ISC ($10^{6.4}$) protected mice against a challenge dose of 10^2 to 10^5 VI/sub b/ cells; more than 10^5 VI/sub b/ cells were lethal. Two techniques were used to quantify immunity even though mice

ultimately died of transplanted leukemia, viz., mean survival time (MST) with a fixed challenge dose of VI/sub b/ cells, or MST with a fixed time for death. The sensitivity and statistical limitations of these assays are presented. To amplify the sensitivity of assays for adoptive cellular immunity a technique of antigenic stimulation was used, viz., 1 day after x-irradiated mice (600 R) received an i.p. injection of normal or immune spleen, bone marrow or thymic cells they received an i.p. injection of XI/sub b/ cells containing an admixture of VI/sub b/ cells. The technique amplified the sensitivity of ISC transfer tests approximately 100-fold and made it possible to detect protective effects of bone marrow and thymic cell populations. (auth)

529 OPTICAL BEAM SHAPING DEVICES USING POLARIZATION EFFECTS. Simmons, W. W.; Leppelmeier, G. W.; Johnson, B. C. (Univ. of California, Livermore). Appl. Opt.; 13: No. 7, 1629-1632(Jul 1974).

The construction and performance are described of two devices which use the Faraday and Pockels effects, respectively, to obtain smoothly varying transmission functions through radial variation of the beam polarization. Application to beam shaping for lasers of high power with large aperture is mentioned. (Elect. Electron. Abstr.)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 1595, 1602, 1603, 1605, and 1621.

530 (AD/A-001649) PROGRAM FOR THE DEVELOPMENT OF A SUPERCONDUCTING GENERATOR. Part I, Phase I. Report for May 1971–January 1974. Blaugher, R. D.; McCabria, J. L.; Parker, J. H. Jr. (Westinghouse Electric Corp., Lima, Ohio (USA). Aerospace Electrical Div.). Oct 1974. Contract F33615-71-C-1591. 242p. (AFAPL-TR-74-84-PT-1). NTIS $7.50.

The work included the preliminary studies and design of a 12,000 rpm, 5 MVA, 400 Hz generator with a rotating field. It also includes the individual tests of the most critical components, i.e., the dynamic cryogenic seals, power leads, interconnections of the sc coils, sc field windings, and construction and test of a complete rotor. The cold rotor tests (at. 4.2 K) were conducted up to the overspeed value of 13,200 rpm. Full excitation of the field (equivalent to 5.32 MVA) was obtained at the operating speed of 12,000 rpm. (GRA)

531 (AD/A-002479) SUPERCONDUCTING-CAVITY STABILIZED OSCILLATOR AND AN EXPERIMENT TO DETECT TIME VARIATION OF THE FUNDAMENTAL CONSTANTS. Stein, S. R. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.). Oct 1974. Contract N00014-67-A-0112-0076. 111p. (HEPL-741). NTIS $5.25.

A precision microwave oscillator system was developed which has a superconducting cavity as its frequency determining element. The frequency stability of the device, called the superconducting-cavity stabilized oscillator (SCSO), was studied using both spectrum analysis and period measurement techniques. For times shorter than one-thousand seconds the frequency fluctuations, as measured by the Allan variance, are smaller than for any other high stability frequency source; the noise floor of the fractional frequency fluctuations is 10^{-16} power at the present time. The long term performance of an ensemble of SCSO systems has been measured relative to the frequency of a cesium-beam frequency standard. (GRA)

532 (COM-72-10571-02) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, April–June 1972. Issue No. 72-2. Goree, W. S.; Edelsack, E. A.; Kamper, R. A.; Olien, N. A. (comps.). (Superconducting Technology, Inc., Mountain View, Calif. (USA); Office of Naval Research (USA). London Branch Office; National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1973. 32p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

533 (COM-72-10571-03) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, July–September 1972. Issue No. 72-3. Goree, W. S.; Edelsack, E. A.; Kamper, R. A.; Olien, N. A. (comps.). (Superconducting Technology, Inc., Mountain View, Calif. (USA); Office of Naval Research (USA). London Branch Office; National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1972. 33p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

534 (COM-72-10571-04) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, October-December 1972. Issue No. 72-4. Goree, W. S.; Nisenoff, M.; Wolf, S. A.; Kamper, R. A.; Olien, N. A. (comps.). (Superconducting Technology, Inc., Mountain View, Calif. (USA); Naval Research Lab., Washington, D. C. (USA); National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1972. 68p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

535 (COM-73-1065-01) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, January–March 1973. Issue No. 73-1. Goree, W. S.; Nisenoff, M.; Wolf, S. A.; Kamper, R. A.; Olien, N. A. (comps.). (Superconducting Technology, Inc., Mountain View, Calif. (USA); Naval Research Lab., Washington, D. C. (USA); National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1973. 31p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

536 (COM-73-10665-02) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, April–June 1973. Issue No. 73-2. Goree, W. S.; Nisenoff, M.; Wolf, S. A.; Kamper, R. A.; Olien, N. A. (comps.). (Superconducting Technology, Inc., Mountain View, Calif. (USA); Naval Research Lab., Washington, D. C. (USA); National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1972. 47p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

537 (COM-73-10665-04) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, October–December 1973. Issue No. 73-4. Olien, N. A.; Goree, W. S.; Kamper, R. A.; Nisenoff, M.; Wolf, S. A.; Edelsack, E. A. (comps.). (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards; Superconducting Technology, Inc., Mountain View, Calif. (USA); Naval Research Lab., Washington, D.C. (USA); Office of Naval Research, Washington, D. C. (USA)). 1973. 73p. NTIS.

Each issue lists about 200 new papers, reports, and patents, covering applied superconductivity. The references include author, title, and bibliographic citations and are listed under 39 subject headings. Most references are listed under two or more

headings. A complete author index is included in each issue. The references are obtained from the Cryogenic Data Center's Information System which contains the world's most comprehensive collection of literature in the field of cryogenics. Each issue also includes a two to three page survey of the more significant papers listed in that issue. The survey is written by a leading expert in the field of applied superconductivity. (auth)

538 FABRICATION OF SMALL MICROBRIDGES. Chiao, R. Y.; Feldman, M. J.; Ohta, H.; Parrish, P. T. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 183-185(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A simple, versatile technique for making very small, sturdy, reproducible microbridges is described. When exposed to air, to mechanical shock, or to repeated temperature cycling, the junctions do not deteriorate over long times. They can be as small as 2000 Å wide by 1000 Å long. Methods for obtaining strongly adherent, small-grained, homogeneous tin film, and for the protection of the junctions from electrical pulses, are also described. (auth)

539 SEMIMETAL BARRIER PLANAR JOSEPHSON JUNCTION. Ohta, H.; Feldman, M. J.; Parrish, P. T.; Chiao, R. Y. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 187-190(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The semimetal barrier planar junction is an excellent candidate for a millimeter-wave detector. It has a high resistance and a very small capacitance, it is electrically and mechanically stable, and it can easily be made in the small-junction limit. The fabrication and characteristics of such junctions are described. (auth)

540 PREPARATION OF MICROBRIDGES AND SMALL AREA TUNNEL JUNCTIONS. Kofoed, B.; Jensen, B. U.; Saermark, K. (Technical Univ. of Denmark, Lyngby). Rev. Phys. Appl.; 9: No. 1, 191-194(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

An evaporation technique for preparation of thin-film weak links with a width smaller than 1 μm and tunnel junctions with an area smaller than 1 μm $\times$ 20 μm is described. Some examples of I–V characteristics and the influence of microwaves on the characteristics are given. (auth)

541 FIELD-USABLE SHARPLESS WAFERS FOR JOSEPHSON EFFECT DEVICES AT MILLIMETER WAVES. Edrich, J. (Univ., Denver); Cupp, J. D.; McDonald, D. G. Rev. Phys. Appl.; 9: No. 1, 195-197(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

It is shown how modified Sharpless wafers can be used for point contact Josephson effect detectors, converters, oscillators and parametric amplifiers. First experimental data indicate that this method results in devices that are rugged, can be permanently adjusted at room temperature and can be cycled in temperature. (auth)

542 INTERACTIONS IN SMALL SYSTEMS OF COUPLED JOSEPHSON JUNCTIONS AT MICROWAVE FREQUENCIES. Finnegan, T. F.; Wilson, J.; Toots, J. (National Bureau of Standards, Washington, DC). Rev. Phys. Appl.; 9: No. 1, 199-205(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A major factor in the practical utilization of any Josephson device for microwave and higher frequency applications (such as the generation and detection of electromagnetic radiation) is the success with which the junction device can be coupled to an external transmission line. As part of an experimental investigation of the electrodynamics of small arrays of Josephson tunnel junctions, the properties of the coherent radiation emitted both by individual junctions and by coupled junction systems have been studied at frequencies between 2 and 12 GHz. Near 9 GHz, more than 10^{-9} of coherent radiation has been detected from a single Pb–Pb oxide–Pb junction coupled via waveguide. The development of thin film devices in which the tunnel junctions form part of a microstrip line have made it feasible to observe directly (in a single device) the radiation emitted both at the fundamental geometrical frequency and at the low order harmonics. The observed temperature dependence of the junction cavity Q indicate the low temperature losses are primarily due to cavity loading of the external transmission line. (auth)

543 DETECTION AND EMISSION OF RADIATION BY ARRAYS OF JUNCTIONS. Clark, T. D. (Cornell Univ., Ithaca, NY). Rev. Phys. Appl.; 9: No. 1, 207-216(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The interaction of small regular planar arrays of point contact Josephson junctions with an electromagnetic field, either self-generated or externally applied is discussed. The experimental data obtained are reviewed in terms of a single frequency, superradiant state for the point contact array. (auth)

544 COHERENT AND PARACOHERENT STATES IN JOSEPHSON-COUPLED GRANULAR SUPERCONDUCTORS. Rosenblatt, J. (Institut National des Sciences Appliquees, Rennes, France). Rev. Phys. Appl.; 9: No. 1, 217-222(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The order parameter of an assembly of superconducting grains of diameter greater than the coherence length is a set of vectors in the complex plane. It is shown that if the grains are coupled through the Josephson effect, the system is the analog of a Heisenberg ferromagnet with spin dimensionality 2. A phase transition occurs from a paracoherent state to a coherent one above and below, respectively, a coherent temperature $T_0 < T_c$. It is only in the latter domain of temperatures, where superconducting phases are ordered, that Josephson effects will be fully displayed by the system as a whole. Approximate equations of motion are derived and thereby effects due to phase fluctuations upon the DC characteristics are studied theoretically and experimentally. The systems obey London electrodynamics and possess peculiar quantum interference properties. (auth)

545 PARAMETRIC EXCITATION OF PLASMA OSCILLATIONS IN JOSEPHSON JUNCTIONS. Pedersen, N. F.; Samuelsen, M. R.; Saermark, K. (Technical Univ. of Denmark, Lyngby). Rev. Phys. Appl.; 9: No. 1, 223-225(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Experiments on a Josephson junction analog showed a parametric excitation of the plasma resonance. The experimental conditions were that the junction was dc biased in the supercurrent mode, and that the applied rf-power exceeded a certain threshold value depending on the circuit losses. The frequency of the applied rf was approximately twice the plasma frequency. The observed half harmonic generation with big amplitude may be understood from a discussion of the stability properties of the Mathieu differential equation. (auth)

546 FOUR PHOTON PARAMETRIC AMPLIFICATION. Parrish, P. T.; Feldman, M. J.; Ohta, H.; Chiao, R. Y. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 229-232 (Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

An analysis is presented describing four-photon parametric amplification in an unbiased Josephson junction. Central to the theory is the model of the Josephson effect as a nonlinear inductance. Linear, small signal analysis is applied to the two fluid model of the Josephson junction. The gain, gain-bandwidth product, high frequency limit and effective noise temperature is calculated for a cavity reflection amplifier. The analysis is extended to multiple (series-connected) junctions and subharmonic pumping. (auth)

547 MIXING IN SUPERCONDUCTING WEAK LINKS: NUMERICAL CALCULATIONS AND EXPERIMENTAL RESULTS. Auracher, F.; Van Duzer, T. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 233-241(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Numerical calculations on the properties of superconducting weak links as mixers with external local oscillators (LO) are reported. The calculations are based on the resistively shunted-junction model. It is assumed that the LO and the signal are ideal current sources of amplitudes I_{LO} and I_s and of frequencies ω_{LO} and ω_s, respectively. The IF voltage is calculated across the weak link as a function of the bias current, the LO current amplitude I_{LO}, and the normalized signal frequency $\Omega_s = \hbar\omega_s/(2\,eI_cR)$, where I_c is the critical current and R is the shunt resistance. If ω_{IF}/ω_{LO} and I_s/I_c are small, a linear IF response is found. Using this method the frequency dependence of the IF response is found, the conversion efficiency for the matched case in both the

absence and the presence of noise is estimated, and the required LO power is calculated. Thin-film constrictions were fabricated by using electron lithography. Constrictions of indium films were made with thicknesses of ≈1200 Å with widths as narrow as 2000 Å and lengths as short as 1000 Å and their I–V characteristics were studied in the presence of RF radiation and their X-band mixing properties were measured. An NEP of 10^{-13} W/Hz^{½} and a dynamic range of 23 dB (3 dB deviation from linearity) were measured and it is estimated that with optimum matching these would become 3×10^{-18} W/Hz^{½} and 74 dB, respectively. (auth)

548 ANALOG COMPUTATION OF HETERODYNING WITH A VOLTAGE-BIASED JOSEPHSON POINT-CONTACT. Erne, S. N. (Physikalisch-Technische Bundesanstalt, Brunswick). Rev. Phys. Appl.; 9: No. 1, 243-247(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A system consisting of two resonant circuits coupled inductively with a resistive SQUID was investigated using an analog computer. Results of special interest for microwave receiver application, namely spectra of heterodyning products, frequency shifting and operation at zero input, are reported. (auth)

549 THEORY OF FREQUENCY MIXING. Chang, C. S.; Stehle, P. (Univ. of Pittsburgh). Rev. Phys. Appl.; 9: No. 1, 249-254(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A quantum field-theoretic method to describe the effect of frequency mixing using Josephson junctions or using an electron beam traversing a succession of microwave cavities is developed. One purpose is to discuss the basic mechanism of current modulation and the subsequent radiation in the complete quantum mechanical context. The Heisenberg picture is used so that the field operators depend on time and state vectors are fixed. It is essential to take quantum mechanical expectation values only for the quantities that are actually observed. Thus, in the case of frequency mixing, we do not evaluate the current but rather the radiated power, which is observable. An evaluation of the current would destroy correlations between Fourier components of the current produced in the first cavity or in the first junction. Leaving the current as an operator permits the correlations produced in the first cavity (junction) to affect the radiation in the second cavity (junction). Another purpose of the approach is to find the possible dependence of the output radiation on the quantum state of the incident radiation preexisting in cavities or in Josephson junctions. In the case of frequency mixing using two microwave cavities where the fields are treated as independent. It is shown that it is possible to distinguish the case where both cavities are in definite phase-certain coherent states from the phase-uncertain number states by the value of the wave function renormalization constant. However, if the relative phase of the two cavities cannot be defined, this distinction disappears. This indicates that the radiation occurs at the beat frequency even when the cavity fields are taken to be in energy eigenstates, so that no phase whatever can be associated with the fields in those cavities and thus a classical velocity modulation picture does not apply. (auth)

550 JOSEPHSON JUNCTION MIXER USING AN EXTERNAL LOCAL OSCILLATOR. Kanter, H. (Aerospace Corp., Los Angeles). Rev. Phys. Appl.; 9: No. 1, 255-262(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Mixing experiments on niobium point contacts are reported for conversion from 95 GHz to 140 MHz. The conversion efficiency is less than predicted by the highly damped weak link model. The discrepancy is presumably due to mixing with higher harmonics of the local oscillator. The lowest noise temperature measured was T ≈ 100°K which is of the same order as recently reported for cooled Schottky-barrier diodes. (auth)

551 CONVERSION GAIN AND NOISE IN A JOSEPHSON MIXER. Taur, Y.; Claassen, J. H.; Richards, P. L. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 263-268 (Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Fundamental mixing at 36 GHz in non-hysteretic Nb point contacts has been observed with overall conversion efficiencies in the range $0.33 \leq \eta \leq 4$ and mixer noise temperatures in the neighborhood of $T_M \approx 200$°K. The observed conversion efficiencies are in good agreement with the resistively shunted junction model. The observed noise can be accounted for by assuming that the Johnson noise in the shunt resistor is the only source of noise driving the junction. Somewhat larger noise is seen from resonantly coupled mixers than is seen when the mixer is driven from an rf current source. Fundamental mixing in hysteretic junctions is limited to a narrow if bandwidth and gives much larger conversion gain but also larger noise. Parametric amplification at the if frequency is seen in hysteretic junctions. Fourth order harmonic mixing with $\omega_{LO}/2\pi$ at 9 GHz has been achieved with performance almost comparable to fundamental mixing. Cavity mode mixing appears less promising. (auth)

552 RESPONSE OF A JOSEPHSON RECEIVER WITH A Nb_3Sn RIBBON CONTACT AT 70 GHz. Gygax, S.; Zingg, W. (Univ., Geneva). Rev. Phys. Appl.; 9: No. 1, 269-271(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The construction of a R-SQUID which acts as a mixer and local oscillator in the 4 mm range is described in detail. A strong frequency dependence of the detected signal is found and its dependence on the incident microwave power indicates that the device acts as a square law detector for low power levels and as a linear detector for the higher ones. A sensitivity of 10^{-15} W was achieved. (auth)

553 FREQUENCY CONVERSION WITH SUPERCONDUCTING POINT CONTACTS OPERATING AS OSCILLATOR-MIXERS AND ITS APPLICATION TO THE MEASUREMENT OF THE LINE-WIDTH OF THE JOSEPHSON CURRENT AT VERY HIGH FREQUENCY. Vernet, G.; Adde, R. (Paris Univ., Orsay, France). Rev. Phys. Appl.; 9: No. 1, 275-278(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The Josephson frequency conversion in the millimeter and submillimeter wave region is studied with superconducting Nb–Nb point contact junctions at 4.2°K, using the contact both as the local oscillator and the mixer with intermediate frequencies of 0.1 and 9.2 GHz. Frequency conversion signals are only detected in the latter case with a microwave receiver at 9.2 GHz in a range of Josephson frequencies between 145 and 1600 GHz. The experiments with intermediate frequency f_i of 0.1 GHz indicate for this small value of f_i that the observed signals are not related to frequency conversion but noise effects. An analysis of the frequency conversion mechanism in a Josephson junction operated as an oscillator-mixer is proposed which includes the noise effects and also the feedback effects induced in a junction driven by a constant current source. The noise properties up to 450 GHz of superconducting point-contacts were investigated using the junction as an oscillator-mixer where the Josephson current is mixed with harmonics of an externally applied signal. The emitted intermediate frequency is detected at 9.2 GHz and its linewidth is measured. In the very high frequency range the dc quasiparticle current dominates in a Josephson weak-link and the corresponding theoretical linewidth calculated by Scalapino is compared with experimental results. (auth)

554 HETERODYNE LASER RADIATION DETECTION AT 891 GHz USING JOSEPHSON POINT CONTACTS. Blaney, T. G. (National Physical Lab., Teddington, Eng.). Rev. Phys. Appl.; 9: No. 1, 279-284(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Experiments were carried out to investigate the performance of a heterodyne detector at 891 GHz using a cw hydrogen cyanide laser as the local oscillator and Nb–Nb point contact Josephson junctions as mixing devices. Using a second off-tuned HCN laser as the signal, intermediate frequencies (IF's) up to a few MHz could be studied. Both pre-set and adjustable types of junction were used, and the latter, arranged so that radiation could be directly focussed onto them gave the best ultimate sensitivity. Dependence of the IF power on dc current bias and local oscillator power is described, and compared with simple theory. IF power varied linearly with signal power for signals less than 10^{-5} to 10^{-6} W. The mixer conversion efficiency was independent of IF. The sensitivity of the detector was a strong function of junction characteristics and ranged over several orders of magnitude in the junctions studied. Noise at the output was dominated by the room temperature preamplifier with a noise temperature of about 500°K. The smallest observed value for conversion loss of the junction was about 29 dB. This figure includes the signal input matching loss. The best sensitivity

of the whole receiving system was equivalent to 1×10^{-17} W/Hz. (auth)

555 SPECTRAL ANALYSIS OF A PHASE LOCKED LASER AT 891 GHz, AN APPLICATION OF JOSEPHSON JUNCTIONS IN THE FAR INFRARED. Wells, J. S.; McDonald, D. G.; Risley, A. S.; Jarvis, S.; Cupp, J. D. (National Bureau of Standards, Boulder, CO). Rev. Phys. Appl.; 9: No. 1, 285-292(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A Josephson junction was used to investigate the spectral purity of an HCN laser which is used in an infrared frequency synthesis chain. To obtain a narrower linewidth from the laser it has been phase locked to a multiplied microwave reference chain. A calculated value for this linewidth was based upon the measured noise spectrum of the microwave source and a theory due to Middleton. One can take advantage of the unique properties of the Josephson junction as a frequency multiplier and mixer for use in measuring this linewidth. The Josephson junction is driven by an X-band signal which is derived from a specially designed cavity stabilized klystron system of high spectral purity. The 92nd harmonic of the X-band signal is generated in the Josephson junction. In addition, the Josephson junction acts as a mixer of the harmonic signals and the 891 GHz output of the HCN laser. The 92nd harmonic beat signal is taken from the Josephson junction, amplified, and sent to a spectrum analyzer for frequency domain analysis. Details of the experiment, results, and relation to predicted linewidths are presented. (auth)

556 JOSEPHSON DETECTORS OF MILLIMETER ELECTROMAGNETIC RADIATION. Kulikov, V. A.; Kurdjumov, N. N.; Leshchenko, G. F.; Matveets, L. V.; Migulin, V. V.; Soldatov, E. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Rev. Phys. Appl.; 9: No. 1, 293-294(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The possibility of construction of high sensitive detectors of electromagnetic radiation on the base of Josephson point contacts has been studied in detail. This communication is devoted to detectors of electromagnetic radiation in the upper millimeter range, designed for use in radioastronomy, in particular for experimental investigation of radiation spectra of celestial objects. (auth)

557 VORTEX PROPAGATION AND RADIATION EMISSION IN JOSEPHSON TUNNEL JUNCTIONS. Fulton, T. A.; Dunkleberger, L. N. (Bell Telephone Labs., Murray Hill, NJ). Rev. Phys. Appl.; 9: No. 1, 299-303(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The fundamental frequency of emitted radiation from a Josephson tunnel junction biased on a zero-field step is measured and found to obey the voltage-frequency relation $eV = hf$, as predicted by the vortex-motion picture. Some aspects of radiation emission by large-critical-current junctions are also considered. (auth)

558 MICROWAVE RESISTIVE SQUID FOR NOISE THERMOMETRY. Soulen, R. J.; Finnegan, T. F. (National Bureau of Standards, Washington, DC). Rev. Phys. Appl.; 9: No. 1, 305-307(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A SQUID magnetometer has been shown to work at 10 GHz with a significant enhancement of signal-to-noise over 30 MHz devices. This article describes how such enhancement could lead to faster determinations of absolute temperature using a resistive SQUID, i.e., a noise thermometer. A prototype 10 GHz resistive SQUID is described and its performance evaluated. The feasibility of using a 10 GHz system is clearly established. (auth)

559 ONE POSSIBILITY OF SOLVING THE IMPEDANCE PROBLEM FOR JOSEPHSON JUNCTIONS. Bystrov, V. A.; Dmitriev, V. M.; Pavlyuk, V. A. (Physico-Technical Inst. of Low Temperatures, Kharkov). Rev. Phys. Appl.; 9: No. 1, 309-311(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The problem of electromagnetic radiation from a system of tunnel junctions through a partially transparent screen is solved. A condition is derived for matching to free space the high-frequency energy generated by the Josephson junctions. The condition can always be satisfied by appropriate choice of reflective characteristics and position for the semitransparent screen. Examples are given of the use of this approach in coupling to a waveguide and to a resonant cavity. (auth)

560 JOSEPHSON EFFECT. Libchaber, A. (Ecole Normale Superieure, Paris). Rev. Phys. Appl.; 9: No. 1, 1-3 (Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Topics related to Josephson effects where the theoretical situation is complicated, and experiments are still not in a satisfactory stage are discussed. These include (1) the appearance of a new dissipative $\cos \varphi$ term, where φ is the phase difference between the two superconductors; (2) the microwave response of a Josephson diode at photon energies near the energy gap; and (3) the effect of microwaves on critical current in the so-called Dayem bridges. (auth)

561 CURRENT STATE OF COMPETING (NON JOSEPHSON JUNCTION) TECHNIQUES. Penzias, A. A. (Bell Telephone Labs., Holmdel, NJ). Rev. Phys. Appl.; 9: No. 1, 7-13(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Great strides have been made in recent years as the technology employed in the generation and detection of electromagnetic radiation is pushed toward centimeter, millimeter, and submillimeter wavelengths. We review, briefly and from a very practical standpoint, the present state and immediate prospects of devices in a number of areas in which one might consider the possible use of Josephson junction techniques. These include: (1) sources for wavelengths longer than about 2 mm are readily available, while shortward of a few hundred microns wavelength a large number of discrete and tunable laser sources exist. In the remaining decade in wavelength, harmonic generation may be used; (2) incoherent detection is largely done with bolometers of various types. They have been extensively described in the literature and will be only briefly reviewed here; (3) superheterodyne mixers employing Schottky barrier diodes have been used extensively at wavelengths toward one millimeter. Efforts to extend their usefulness to shorter wavelengths and to improve their sensitivity by cooling will be described in detail; (4) an InSb hot carrier bolometer has been used as a superheterodyne detector at 2.5 and 1.2 mm wavelengths. It is expected that this device can maintain its level of performance to about 300 μ, although its bandwidth at any wavelength is quite limited, and; (5) masers and parametric amplifiers can presently be used to about one centimeter wavelength. It seems possible to realize such devices at somewhat shorter wavelengths as well. Examples of each of these devices are given, and, as far as possible, their relative merits for a number of general applications compared. (auth)

562 ELECTRONIC EQUIVALENT SCHEME OF A JOSEPHSON JUNCTION. Bak, C. K. (Technical Univ. of Denmark, Lyngby). Rev. Phys. Appl.; 9: No. 1, 15-18(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

It is shown that a phase-locked loop is a rather close approximation to a real junction. A lot of phenomena observed in Josephson junctions are easily identified in the "equivalent circuit." It is further shown that the inclusion of an upper cutoff frequency in the loop gain causes a conductivity term similar to the $\cos \varphi$-term experimentally observed in plasma resonance experiments. (auth)

563 ELECTRICAL BEHAVIOR OF SUPERCONDUCTING THIN-FILM MICROBRIDGES. Self-Heating and Superconducting Quantum Processes. Skocpol, W. J.; Beasley, M. R.; Tinkham, M. (Harvard Univ., Cambridge, MA). Rev. Phys. Appl.; 9: No. 1, 19-23(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Measurements of the I–V curves of superconducting thin-film microbridges are reported and used to infer some new results regarding the electrical behavior of these devices. At temperatures well below T_c their behavior is found to be dominated by the effects of self-heating. At low voltages near T_c where heating is not important, it is found that the observed behavior is best understood in terms of a phase-slip mechanism and that the normal currents which flow during the phase-slip process extend over a range determined by the quasiparticle

diffusion length. Even near T_c heating becomes important at high voltages and probably puts a limit on the maximum voltage (hence Josephson frequency) up to which useful Josephson-like behavior can be obtained. (auth)

564 SOME ANALYTICAL RESULTS FOR THE RESISTIVELY SHUNTED JOSEPHSON JUNCTION. Renne, M. J.; Polder, D. (Technische Hogeschool, Delft, Netherlands). Rev. Phys. Appl.; 9: No. 1, 25-28(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Some analytical results for the resistively shunted Josephson junction, fed with an ac current in addition to a dc current, are reported. The original nonlinear differential equation for the phase difference of the order parameter is transformed to a linear second order differential equation with periodic coefficients. From this equation the possibility for harmonic current steps and the absence of subharmonic steps may be inferred. Furthermore, for low values of the ac current amplitude and frequency the step height of the first few steps is calculated in the tight binding approximation. At high frequencies the free electron approximation is used for the evaluation of the step heights for arbitrary values of the amplitude; it follows that the step heights behave like Bessel functions. These results are qualitatively in agreement with numerical calculations by Russer and others. (auth)

565 SUBHARMONIC STEPS IN THE I–V CHARACTERISTIC OF SHORT MICROBRIDGES DUE TO NON-SINUSOIDAL CURRENT-PHASE RELATIONS. Luebbig, H.; Luther, H. (Physikalisch-Technische Bundesanstalt, Brunswick). Rev. Phys. Appl.; 9: No. 1, 29-34(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The influence of high order harmonics ($I_k \sin k\varphi$, $k > 1$) of the current-phase relation $I(\varphi)$ of a short superconducting microbridge on the corresponding rf-induced current-voltage characteristic is studied. For a special non-sinusoidal relation $I(\varphi)$ derived from the model of Baratoff et al., the step-heights are calculated as a function of the amplitude of the applied rf-field. An approximation method for the determination of the spectrum I_k of $I(\varphi)$ by means of an evaluation of the given step-structure is discussed. (auth)

566 PHYSICAL INTERPRETATION OF THE COS φ TERM AND IMPLICATIONS FOR DETECTORS. Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). Rev. Phys. Appl.; 9: No. 1, 35-40(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Theoretical calculations of the total current in a superconductor-barrier-superconductor device based on the conventional tunneling Hamiltonian yield three terms, conventionally termed the Josephson supercurrent or pair current, the quasiparticle current, and the quasiparticle-pair-interference or cos φ current. When reconciled, existing theories predict relative signs of the quasiparticle and quasiparticle-pair currents which are opposite to the results of recent experiments which purport to demonstrate the existence and properties of the latter current. This discrepancy remains unresolved. The cos φ current (whatever its sign) is not expected to give rise to qualitatively new and striking phenomena in Josephson devices, but may quantitatively affect the dynamical and fluctuation behavior of these devices in a variety of ways. (auth)

567 COS φ TERM IN JOSEPHSON'S EXPRESSION FOR THE TUNNELING CURRENT. Poulsen, U. K. (Technical Univ. of Denmark, Lyngby). Rev. Phys. Appl.; 9: No. 1, 41-44(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Recently there has been some interest in the cos φ dependent term in the expression for the tunneling current given by B. D. Josephson. The result of numerical calculations on this term is presented, and it is shown that although the cos φ term theoretically affects the ac-current in a dc-voltage biased junction the term cannot — in practice — be verified from a relative measurement of this current. In addition, the only experiments in which the cos φ term — so far — has been shown to have observable effects are considered. Also some model calculations on I–V characteristics are mentioned. (auth)

568 PHYSICAL PROCESSES IN PROXIMITY MICROBRIDGES. Mercereau, J. E. (California Inst. of Tech., Pasadena). Rev. Phys. Appl.; 9: No. 1, 47-52(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Weakly superconducting circuits have been developed — based on the proximity effect in hard superconductors — which show Josephson-like phenomena over a wide range of electrical and superconducting parameters. Characteristics of these circuits are discussed and a simple physical model is presented to account for a modification of the Josephson phenomena at high current density in these devices. Response of the devices at high frequency is emphasized with special emphasis on detection processes and the Dayem-Wyatt effect. (auth)

569 dc RESPONSIVITY OF PROXIMITY EFFECT BRIDGES TO HIGH FREQUENCY RADIATION. Hauser, M. G.; Palmer, D. W. (California Inst. of Tech., Pasadena). Rev. Phys. Appl.; 9: No. 1, 53-60(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The effect of microwave radiation on the dc current-voltage characteristic of proximity effect bridges has been studied at frequencies of 10, 35 and 90 GHz. The properties of bridges fabricated in layered films of Nb and Ta are reported. The fraction of ϵ of the incident radiant power absorbed by the bridge is measured calorimetrically, permitting determination of the intrinsic responsivity (volts per watt of power absorbed when operated in a current-biased mode). In the test geometry ϵ is typically $\sim 10^{-4}$ for a 0.1 Ω Nb–Ta bridge, and increases roughly linearly with dc junction resistance R. Broad-band responsivity is generally independent of incident power, increases with increasing critical current I_c (decreasing temperature), and decreases with increasing frequency, varying approximately as Ω^{-3} where Ω is the normalized frequency $\hbar\omega/2\,eRI_c$. Peak responsivities achieved to date are $\sim 10^5$ V/W (absorbed) at 10 GHz and $\sim 10^2$ V/W (absorbed) at 90 GHz. By mounting junctions in vacuum and exposing them to near-infrared radiation, it has been found that their purely bolometric (thermal) response is much weaker than the microwave response at 90 GHz. (auth)

570 SENSITIVITY OF JOSEPHSON-EFFECT MILLIMETER-WAVE RADIOMETER. Ohta, H.; Feldman, M. J.; Parrish, P. T.; Chiao, R. Y. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 61-64(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The noise temperature and the minimum detectable temperature of a Josephson junction in video detection of microwave and millimeter-wave radiation has been calculated. The well-known method based on a Fokker–Planck equation is used. The noise temperature can be very close to ambient temperature. Because its predetection bandwidth is very wide, a Josephson-effect radio telescope receiver can have a minimum detectable temperature better than that of a traveling-wave master. (auth)

571 DETECTION OF MICROWAVE RADIATION USING THIN FILM SUPERCONDUCTING LOOPS CONTAINING WEAK LINKS. Nisenoff, M. (Naval Research Lab., Washington, DC). Rev. Phys. Appl.; 9: No, 1, 65-68(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Thin film superconducting SQUIDs biased at 30 MHz have been used for the detection of electromagnetic radiation in the frequency range from about 1 kHz up to at least 10 GHz. With the improved performance obtained for microwave-excited devices, detection of mm and sub-mm radiation should be possible. Calculated sensitivity for a microwave excited SQUID to radiation at 100 GHz is about 10^{-17} W/$\sqrt{\text{Hz}}$. (auth)

572 SUPERCONDUCTING TUNNEL JUNCTION BOLOMETERS. Clarke, J.; Hoffer, G. I.; Richards, P. L. (Univ. of California, Berkeley). Rev. Phys. Appl.; 9: No. 1, 69-71(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Two new types of superconducting infrared bolometer are described. In one, the temperature dependent Josephson current in an SNS junction is measured with a SQUID galvanometer. In the other, the temperature-dependent quasiparticle tunneling current in an SIN junction is measured with a conventional fet amplifier. Either type of junction is deposited on a low heat capacity sapphire substrate covered on the reverse side with a thin Bi film to absorb infrared radiation. The best performance achieved thus far is for the SNS bolometer which has

an electrical NEP $\approx 5 \times 10^{-15}$ W/$\sqrt{\text{Hz}}$ and $D^* \approx 10^{14}$ cm/W^{-1}/Hz$^{\frac{1}{2}}$. Some improvement in these values is anticipated. (auth)

573 EFFECT OF PREPARATION PARAMETERS ON LIGHT SENSITIVITY IN SUPERCONDUCTIVE TUNNEL JUNCTIONS. Barone, A.; Rissman, P.; Russo, M. (Laboratorio di Cibernetica, Naples). Rev. Phys. Appl.; 9: No. 1, 73-77 (Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Superconductive tunnel junctions which employ cadmium sulphide and cadmium selenide layers as tunneling barrier have been experimentally investigated. These structures exhibit a light-sensitive behavior. Results concerning photoresponse of both Josephson and quasi-particle tunneling junctions are reported. Physcial parameters of preparation in connection with the resulting characteristics of the samples are discussed. (auth)

574 S-c-S JUNCTIONS AS NONLINEAR ELEMENTS OF MICROWAVE RECEIVING DEVICES. Vystavkin, A. N. (Inst. of Radioengineering and Electronics, Moscow); Gubankov, V. N.; Kuzmin, L. S.; Likharev, K. K.; Migulin, V. V.; Semenov, V. K. Rev. Phys. Appl.; 9: No. 1, 79-109(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The analysis of possible phenomena in the superconductor-constriction-superconductor (S-c-S) junctions inserted into microwave circuits is carried out. The results of experiments in which properties of the junctions making them different in comparison with usual nonlinear microwave elements were studied are discussed. The characteristics of receiving devices such as amplifiers, detectors and converters operating on the basis of these phenomena are obtained. The limit characteristics of these devices in different regimes of operation are analyzed and compared with experimentally achieved characteristics. It is shown that the noise properties of the receiving devices utilizing the S-c-S junctions close to ideal can be obtained for the frequencies lower than characteristic frequency of the junction. This frequency for known realizations of the S-c-S junctions (point contacts and thin film bridges of small dimensions) can reach of order of 500 to 1000 GHz or in other words of the middle of the submillimeter waveband range. (108 references) (auth)

575 JOSEPHSON JUNCTION DETECTOR FOR ASTRONOMICAL APPLICATIONS. Ulrich, B. T. (Univ. of Texas, Austin). Rev. Phys. Appl.; 9: No. 1, 111-118(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A wide-band detector for the 1.0 to 1.6 mm atmospheric transmission window has been developed for astronomical observations at the McDonald Observatory 2.7 m optical telescope. For observations of continuum astronomical sources, the relevant figure of merit is the "Noise Equivalent Temperature" or δT_{rms}. The present $\delta T_{rms} = 0.25$ K for a 1 s observation. The astronomical objects which have been observed so far include the sun, moon, Venus, Jupiter, 3C 273 and the galactic center. With the present detector sensitivity, a 1 mm source of 0.7 flux units would give a signal to noise of one for a 3 h observation at the NRAO 11 m telescope. The detector uses a point contact Josephson junction, with a niobium point against tin. The junction is mounted coaxially in a multimode 5 mm diameter cylindrical cavity which is coupled by a cone to a 5 mm oversize circular wave guide leading up the neck of the dewar. The wide-band mode of operation is used, in which the incident continuum radiation from an astronomical source causes a depression of the junction critical current. The junction is biased with a 20 Ω source resistance, and the change in bias voltage due to the change in the junction critical current is measured. Two modes are used to chop the 1 mm radiation incident on the junction. For bright astronomical sources such as the sun and the moon, a total power chopper at the entrance of the wave-guide alternately opens and closes the radiometer entrance. For faint sources, a differential chopper chops between the source and adjacent sky. (auth)

576 JOSEPHSON JUNCTIONS AS RESONANT DETECTORS. Andriesse, C. D. (Univ. of Groningen, Netherlands). Rev. Phys. Appl.; 9: No. 1, 119-123(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The single resonance is treated of a cavity, which is driven by an appropriately biased Josephson junction and an external field at resonance frequency. A tunable Fabry-Pérot cavity, based on a flat point-contact device, as a possible narrow-band detector of far-infrared radiation is described. Preliminary experimental data for this system indicate that the principle works, but that the coupling of tunnel currents with the resonance still falls short by an order of magnitude. Modifications are discussed that will improve its performance. (auth)

577 SOME CHARACTERISTICS OF JOSEPHSON JUNCTIONS AS RADIATION DETECTORS. Divin, Yu. Ya.; Nad, F. Ya.; Polyanskii, O. Yu.; Volkov, A. F. (Inst. of Radioengineering and Electronics, Moscow). Rev. Phys. Appl.; 9: No. 1, 125-130(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The V-I characteristic of Josephson junction with an external parallel admittance, the high frequency impedance and high frequency response of a Josephson junction to small external signal are calculated by analytical method. The experimentally obtained spectral response curves for the superconducting point contacts in the frequency range 5 to 30 cm^{-1} are presented. The conditions needed for achieving high sensitivity of superconducting point contacts and superconducting bridges are determined. (auth)

578 STRIPLINE COUPLING OF THIN-FILM JOSEPHSON JUNCTIONS TO EXTERNAL CIRCUITS AT MICROWAVE FREQUENCIES. Sirkeinen, Y.; Somervuo, P.; Wiik, T. (Helsinki Univ. of Tech., Otaniemi, Finland). Rev. Phys. Appl.; 9: No. 1, 131-133(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

A certain way of coupling to the thin-film Josephson tunneling junction has been studied. The coupling structure comprises a superconducting stripline which is terminated to the edge of the Nb-oxide-Pb junction. A mismatch of 23 dB has been obtained so far between the signal source and the junction at X-band compared to the earlier estimates of 40 dB between conventional size outer circuits and the junction. Prospects for improving the coupling are good. Methods of estimating the voltage and power which are coupled to the junction are given. (auth)

579 ELECTROMAGNETIC PROPERTIES OF THE DAYEM BRIDGE. Levinsen, M. T. (Univ. of Copenhagen). Rev. Phys. Appl.; 9: No. 1, 135-144(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The first measurements on the Dayem bridge showed that the behavior of an applied microwave field was quite different from that of the Josephson tunnel junction. Measurements on bridges one magnitude smaller later showed this difference to result from the bridge size. A very simple equivalent circuit was furthermore shown to characterize these small bridges. Analog computer calculations on this circuit will be compared to experimental results. At high temperatures a rounding of steps and supercurrent presumably due to noise is observed. A comparison with the theory of Ambegaokar and Halperin is presented. At low temperatures a hysteresis develops. This may result from the bridge capacitance which also may give rise to subharmonic steps. However, the magnitude (1 pF) inferred from the hysteresis is too small to account for the subharmonic steps actually observed. In contrast to other types of junctions the bridge is mechanically very robust. We have therefore been interested in the applicability of the bridge. An upper limit to the sensitivity to 10 GHz radiation has been found in terms of NEP to 9×10^{-14} W/$\sqrt{\text{Hz}}$. Furthermore, we have demonstrated that mixing via the Josephson effect is possible. The power dependence of the sum and difference steps is in fair agreement with analog computer calculations on the equivalent circuit. It has been debated whether the bridge radiates at all. By the observation of a cavity induced step we have now established that bridges do radiate. (auth)

580 SUBHARMONIC ENERGY GAP STRUCTURE AND GAP-ENHANCEMENT BY THE JOSEPHSON RADIATION IN SMALL DAYEM BRIDGES. Gregers-Hansen, P. E.; Pickett, G. R. (Univ. of Copenhagen). Rev. Phys. Appl.; 9: No. 1, 145-152(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

We have observed subharmonic energy gap structure in the I-V characteristics of thin film indium and tin microbridges occurring at voltages of $2\Delta/Ne$. Under the influence of microwaves the subharmonics develop sidebands at $(2\Delta \pm M\hbar\omega)/Ne$. We explain the observed behavior in terms of pair-breaking in the region of the bridge by the Josephson radiation and have simulated the effect by analogue computation. Through the positions of the subharmonic peaks we deduce that the energy near the bridge is enhanced above the BCS bulk value, apparently by the Josephson radiation. (auth)

581 EFFECT OF rf ON SUBHARMONIC GAP STRUCTURE IN SUPERCONDUCTING JUNCTIONS. Hoffmann Soerensen, O.; Kofoed, B.; Pedersen, N. F.; Shapiro, S. (Technical Univ. of Denmark, Lyngby). Rev. Phys. Appl.; 9: No. 1, 153-155(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

The rf-power dependence of the structure in the current-voltage characteristic located at the voltage $V = (2\Delta \pm nhv)/me$ has been measured and found very similar to the familiar microwave-assisted tunneling ($m = 1$). 2Δ is the superconducting energy gap, v the applied frequency, $m = 1, 2, 3, \ldots$ and $n = 0, 1, 2, \ldots$. That is, the variation with power of all these structures is found consistent with the expression $J_n^2 (meV_{rf}/hv)$ where $J_n(x)$ is the ordinary Bessel function and V_{rf} the microwave voltage across the junction. (auth)

582 THEORIES OF SUBHARMONIC GAP STRUCTURES IN SUPERCONDUCTING JUNCTIONS. Hasselberg, L. E. (Royal Inst. of Tech., Stockholm); Levinsen, M. T.; Samuelsen, M. R. Rev. Phys. Appl.; 9: No. 1, 157-158(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Two possible explanations of the subharmonic gap structures are presented, i.e., multiparticle tunneling and self-coupling. (1) Multiparticle tunneling yields the subharmonic gap structure and the microwave induced satellites. It also yields the observed power dependence for the satellites. (2) The ac Josephson current excites an rf voltage across the junction with the Josephson frequency. Microwave assisted tunneling due to this rf voltage could account for some of the subharmonic gap structure with the observed power dependence. In order to get all the structure one has to include pair-breaking due to the ac voltage. (auth)

583 MECHANISM FOR NONSTATIONARY BEHAVIOR OF THIN-FILM SUPERCONDUCTING BRIDGES IN THE RESISTIVE CURRENT STATE. Galaiko, V. P.; Dmitriev, V. M.; Khristenko, E. V.; Churilov, G. E. (Physico-Technical Inst. of Low Temperatures, Kharkov). Rev. Phys. Appl.; 9: No. 1, 161-163(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Short Josephson bridges prepared on one face of a rutile resonator show step structure in their I-V curves indicating coupling of generated Josephson currents with various cavity modes. Long (~10 mm) bridges emit radiation in the 30 to 200 MHz range. The radiation occurs when the bridge is in the resistive current state. A model of a dynamic phase lamination, i.e., normal and superconducting phases alternating along the bridge, yields agreement with the experimental observations. (auth)

584 USE OF LOW BARRIER POTENTIAL MATERIALS TO IMPROVE HIGH FREQUENCY COUPLING TO JOSEPHSON TUNNEL JUNCTIONS. Cardinne, P. (Centre d'Etudes Cryogeniques, Sassenage, France); Nordman, J.; Renard, M. Rev. Phys. Appl.; 9: No. 1, 167-171(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Improved high frequency coupling to Josephson tunneling junctions must involve impedance transformation techniques or the fabrication of junctions with more appropriate impedance values. Two kinds of calculations about efficiency of junction coupling with a cavity, one with an antenna and another with an inductive loop show clearly the importance of the term $I_c r_0/\Gamma$ where Γ is the capacitance, I_c the critical current and r_0 a dimension related to the size of the junction. Several ways may be proposed to increase this figure of merit. It appears that, when considering only tunneling phenomena, there is an advantage to decrease the barrier potential height. A number of people have employed semiconductors as barriers because it is possible to use either a naturally narrow forbidden band, or to use the metal-semiconductor interface properties, to get small barrier heights. This paper is devoted to a review of experimental works on junctions using low barrier materials. Attempts have been made with various deposited materials such as Te, PbTe, CdS, CdSe, Ge, InSb, etc., ... But at the present time these trials have not yet been clearly successful. Many problems are related to the use of these materials, some of the more important being: presence of surface states, variation of doping with time, diffusion near the interface, pinholes and amorphous-polycrystalline behavior. Moreover, these various phenomena can lead to several possible mechanisms for explaining conduction in superconductor-semiconductor-superconductor sandwiches. Some of these mechanisms are not compatible with good high frequency coupling. (auth)

585 FABRICATION OF ARRAYS OF SUPERCONDUCTING MICROBRIDGES. Mooij, J. E.; Gorter, C. A.; Noordam, J. E. (Technische Hogeschool, Delft, Netherlands). Rev. Phys. Appl.; 9: No. 1, 173-177(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Two methods have been developed to fabricate superconducting microbridges, i.e., scratching with a diamond point and electron-optical imaging on an electron-sensitive film. With the scratching technique, utilizing a special plate spring arrangement to determine the bridge width, arrays of microbridges have been fabricated. Distances between bridges can be varied at will from 4 μm upwards. Bridge dimensions are approximately 0.5 μm. With electron-optical imaging smaller bridges can be fabricated; the method can easily be extended to the fabrication of arrays. (auth)

586 ION BEAM MACHINING OF NIOBIUM WEAKLY SUPERCONDUCTING MICROBRIDGES. Adde, R. (Paris Univ., Orsay, France); Crozat, P.; Gourrier, S.; Vernet, G.; Bernheim, M.; Zenatti, D. Rev. Phys. Appl.; 9: No. 1, 179-181(Jan 1974).

From international conference on detection and emission of electromagnetic radiation with Josephson junctions; Perros Guirec, France (3 Sep 1973).

Superconducting microbridges of hard superconductors can be realized reproducibly using an ion bombardment technique. The micromachining is obtained directly by focussing onto the superconducting film a reduced ionic image which represents the structure to be machined. The superconducting properties of niobium Josephson microbridges fabricated using this technique are described: critical temperature, normal resistance, I-V characteristic, dc magnetic field effect and microwave field effect. Microbridges with an operating temperature of 4.2°K have been realized. (auth)

587 VOLTAGE OSCILLATION MECHANISM FOR A SUPERCONDUCTING QUANTUM INTERFEROMETER. Gubin, L. P. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 10, 1561-1563(Oct 1974).

Translated from Izmer. Tekh.; 17: No. 10, 54-55(Oct 1974).

It has been observed that an oscillating voltage occurs in response to changing magnetic fields when the current passing through the device exceeds a certain critical value. A weak-coupling model is proposed that explains the nature of the oscillating voltage on a superconducting quantum interferometer when the magnetic flux changes. (WHK)

588 SUPERCONDUCTING MAGNETIC SHIELDS. Bondarenko, S. I.; Sheremet, V. I. (Inst. of Physics and Tech. of Low Temperatures, Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 7, 952-955(Jan 1975).

Translated from Zh. Tekh. Fiz; 44: No. 7, 1528-1533(Jul 1974).

An experimental study has been made of superconducting magnetic shields of various shapes and sizes in external fields from 1×10^{-3} to 350 Oe. The possibility of creating a magnetic "vacuum" by means of superconducting shields is considered. A vacuum of less than 3×10^{-6} Oe has been obtained in a volume of 0.6 liters in an external field of 5×10^{-2} Oe. The stability of the vacuum, measured with a superconducting quantum magnetometer, is better than 1×10^{-6} Oe. (auth)

589 ELECTRODYNAMICS OF JOSEPHSON JUNCTIONS. Rogovin, D. (Department of Physics and Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Phys. Rev. B 11: No. 5, 1906-1908 (1 Mar 1975).

Using the notion of a macrowave function, we show that Josephson radiation arises from oscillations of an overlap charge density localized inside the junction oxide. These oscillations are analogous to those that produce dipole radiation from a two-level atom. (auth)

590 DYNAMIC BEHAVIOR OF SUPERCONDUCTING MICROBRIDGES. Guthmann, C.; Maurer, J.; Belin, M.; Bok, J.; Libchaber, A. (Groupe de Physique des Solides de l'Ecole Normale Supérieure, 24 rue Lhomond, 75231 Paris Cedex 05, France). Phys. Rev. B 11: No. 5, 1909-1913 (1 Mar 1975).

Measurements of the *I-V* curves of superconducting thin-film tin microbridges are reported. A vortex flux-flow model is developed to explain, close to T_c, the regime where a plateau in current is observed. This regime is active when the coherence length ξ is smaller than half the width $w/2$ of the bridge. At temperatures much closer to T_c, where $\xi \geq w/2$, the phase-slip mechanism is effective. (auth)

591 DETERMINATION OF THE CURRENT DENSITY DISTRIBUTION IN JOSEPHSON TUNNEL JUNCTIONS. Zappe, H.H. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Phys. Rev. B 11: No. 7, 2535-2538 (1 Apr 1975).

The magnetic field dependence of the maximum Josephson current $I_m(H_y)$ in tunnel junctions is a function of the integral of the Josephson

current density distribution in the direction of the magnetic field: $j_1(x) = \int j_1(x, y)\, dy$. It is shown that a determination of $j_1(x)$ from $I_m(H)$ is often ambiguous. Cases of different $j_1(x)$ with the same $I_m(H)$ are given. Experimental results of a study of the growth of microshorts in Josephson junctions are presented. Experimental configurations with which $j_1(x)$ can be determined are discussed. (auth)

592 RADIATIONLESS TRANSITIONS IN AROMATIC MOLECULES WITH NONBONDING ELECTRONS: ROLE OF VIBRONICALLY ACTIVE OUT-OF-PLANE MODES. Kanamaru, N.; Lim, E.C. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 62: No. 8, 3252-3257 (15 Apr 1975).

By virtue of their large frequency change and equilibrium displacement, the vibronically active out-of-plane bending modes are argued to be important accepting modes for radiationless transitions of aromatic molecules with nonbonding electrons. The conclusion is shown to be consistent with the position dependence of the deuterium isotope effect in $T_1(\pi\pi^*) \rightarrow S_0$ radiationless transitions of nitrogen-heterocyclic and aromatic carbonyl compounds. (auth)

593 EFFECT OF MICROWAVE IRRADIATION ON THE CURRENT–VOLTAGE CHARACTERISTICS OF THIN–FILM SUPERCONDUCTING TUNNEL JUNCTIONS. Tulin, V.A. (Institute of Solid State Physics, USSR Academy of Sciences). JETP Lett. 20: No. 8, 252-254 (20 Oct 1974).

It is found that microwave irradiation of a superconducting tunnel junction influences the current–voltage characteristics. Depression of the Josephson current and the onset of gapless superconductivity under the influence of the radiation is observed. (auth)

594 NEW SUPERCONDUCTING SWITCH: FIELD-CIRCUIT VERSION. Harrowell, R. W. (PA Tech. and Science Centre, Milton, Eng.). Proc. Inst. Elec. Eng. (London); 122: No. 2, 191-192(Feb 1975).

A new type of superconducting switch, of particular use for the protection of turbogenerators, has recently been proposed (Harrowell, J. Phys. D.; 7: 491-9(1974)). Connected in each phase of the armature, the version described suffered rather high losses and was therefore expensive. A modified form presented employs the same physical principles, but has the switch only in the field circuit. It operates by instantaneously reducing the field current when a fault occurs at or beyond the armature terminals. A number of difficulties were foreseen in the earlier system; most of them are eliminated or alleviated in the new switch. In particular, because the current is direct current and is much less than the armature current, the losses are reduced by much more than a factor of three, and the costs are also sharply reduced. One consequence of the use of the new switch would be a greater freedom in design given by the disappearance of the requirement for high reactances in both generators and transformers as a protection against short-circuit faults. (auth)

595 STATE OF THE ART OF RESEARCH ON SUPERCONDUCTING PULSED MAGNETS. Hsu, S. W. (Inst. of Atomic Energy, Peking). Wu-li; 3: No. 4, 215-221(18 Aug 1974).

The two principal applications of superconducting magnets in high energy physics research are (1) d-c superconducting magnets for bubble chambers, and (2) superconducting magnets for focusing and deflection of charged particles. Specifications of some superconducting magnets in research use in English, France, W. Germany, USA and USSR are reviewed. Economic factors involved in the design of pulsed superconducting synchrotron-type accelerators are considered. Superconducting synchrotron developments are presented. The design of uniform field superconducting dipole magnets, self-field effect, stability of operation, and heat transfer problems are discussed. The directions of research in laboratories around the world such as the Brookhaven National Laboratory, the Lawrence Radiation Laboratory, and the National Accelerator Laboratory in the US are presented. (JPRS)

596 ELECTRON MICROSCOPY HIGH RESOLUTION TEST OF SUPERCONDUCTING OBJECTIVE LENS WITH CLASSICAL FERROMAGNETIC POLE PIECES. Bonhomme, P.; Beorchia, A.; Laberrigue, A. (Univ., Reims, France). Optik; 39: No. 1, 39-46(1973).

Using either conventional objective or superconducting objective lenses with the same aberration coefficients the authors point out an average reduction from 4.8 Å to 4 Å of the smallest phase contrast transferred detail size, i.e., an improving of about 20%. These results are obtained by the study of experimental transfer functions from diffractograms of amorphous carbon electron micrographs. (Elec. Electron. Abstr.)

Heat Transfer and Fluid Flow

Refer also to abstracts 401, 439, 935, 2167, 2297, 2306–2308, 2343, 2402, 2403, and 2553.

597 (AD/A-002073) INFLUENCE OF THE THICKNESS AND THERMAL PROPERTIES OF HEATING WALLS ON THE HEAT TRANSFER COEFFICIENT IN NUCLEATE BOILING. Final Technical Report. Guglielmini, G.; Magrini, U.; Nannei, E. (Genoa Univ. (Italy)). May 1974. Contract DAJA37-73-C-2743. 32p. NTIS $3.75.

An experimental investigation was conducted on saturated pool boiling of water at atmospheric pressure using thin walled electrically heated cylinders made of various metals, and suspended horizontally. These cylinders were made by plating copper, silver, zinc, nickel and tin on non-metallic rods. The wall thickness ranged from 5.0 to 250 micrometers. The experiments have shown that the heat transfer coefficient is strongly dependent upon the wall thickness of the cylinder. Results indicated that if the thermal conductivity of the metal is small, the higher the influence of the wall thickness is. However, no appreciable effect was observed for metals having a higher conductivity, such as copper or silver. (GRA)

598 (LFEN-NI-81-a) FORCED CONVECTION IN ANNULI: SURVEY ON EXPERIMENTAL WORKS. Comprido, A. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1974. 43p. (In Portuguese). INIS.

In the study of forced convective heat transfer in annuli, large discrepances are found between several experimental results and some known analytical solutions. According to that, a general survey on experimental work is presented. After their comparison, some conclusions are reached pointing to further investigation. As the nature of the fluid is an important factor of divergence, the surveyed experimental works were divided into the following groups: air, water, water vapor and other fluids. At the end of each chapter a solution was tried to be found by comparison to other groups. (INIS)

599 (SAND-75-0122) CRUCIB: AN AXISYMMETRIC CONVECTION CODE. Bertram, L. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 45p. Dep. NTIS $5.25.

The CRUCIB code was written in support of an experimental program aimed at measurement of thermal diffusivities of refractory liquids. Precise values of diffusivity are necessary to realistic analysis of reactor safety problems, nuclear waste disposal procedures, and fundamental metal forming processes. The code calculates the axisymmetric transient convective motions produced in a right circular cylindrical crucible, which is surface heated by an annular heat pulse. Emphasis of this report is placed on the input-output options of the CRUCIB code, which are tailored to assess the importance of the convective heat transfer in determining the surface temperature distribution. Use is limited to Prandtl numbers less than unity; larger values can be accommodated by replacement of a single block of the code, if desired. (auth)

600 (WANL-TMI-117) MULTIPLE CHANNEL ANALYSIS PROGRAM (MCAP) FOR THE TEMPERATURE DISTRIBUTION IN AN INTERNALLY-COOLED HEAT GENERATING SOLID COOLED BY A COMPRESSIBLE GAS. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 73p. Dep. NTIS $6.75.

A FORTRAN coded Multiple Channel Analysis Program (MCAP) that was developed to calculate temperature distributions in a heat generating solid is described. The program is general to facilitate the use of various parameters, such as film heat transfer correlations, materials, system configurations and gases. Features of the code include flow balancing in parallel channels, adjustments of power and determination of channel diameters or loss coefficients to meet specified exit conditions, exit pressure may be specified. A step change in pressure may be introduced at an intermediate axial distance and either the total flow rate or pressure drop across the heat exchanger may be specified. Three different power shapes and axial lengths may be in any one problem. Instructions for using the code sample problems with the sample input sheets and the results for these sample problems are included. (auth)

601 (WANL-TMI-751) TWO-PHASE HEAT TRANSFER. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Jul 1963. 12p. Dep. NTIS $4.00.

Two-phase flow and heat transfer measurements on hydrogen flow in a single tube are compared with calculated values from the TRansient Analysis THermal (TRATH) Code. (LCL)

602 (WANL-TMI-1114) HYDROGEN TWO-PHASE NON-EQUILIBRIUM TRANSIENT HEAT TRANSFER DIGITAL CODE. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jun 1964. 33p. Dep. NTIS $4.75.

A two-phase non-equilibrium hydrogen heat transfer code was written and the calculated results compared favorably with both WANL and Lewis Laboratory transient data and Lewis steady state data. The flow model is slug flow and the heat flux is based on super-position of a forced convective heat transfer coefficient and a boiling component. (auth)

603 (WANL-TMI-1810) NOMOGRAPHS FOR HYDROGEN AND HELIUM TANK FARM. Moran, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Jul 1967. 12p. Dep. NTIS $4.00.

Nomographs for helium and hydrogen tank farms are presented that can be used to estimate the amount of time a test can be run given a certain amount of gas and a flow rate. (auth)

604 (WANL-TMI-1921) DEVELOPMENT OF REENTRY BODY ANALYSIS TECHNIQUES, PROGRESS REPORT. Hargrove, H. G.; Shalette, A. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Jul 1968. 54p. Dep. NTIS $5.75.

The development of the SGGEM computer program for describing the motion and aerodynamic heating of body during reentry from space is described. This code was developed for evaluating the performance of satellite heat shields. (LCL)

605 (WANL-TMI-1945) DESCRIPTION OF AIR IMPEDANCE MEASUREMENT TECHNIQUE. DeZubay, E. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Oct 1968. 18p. Dep. NTIS $4.00.

The theory and operation of an air impedance gage used to determine the hole diameter of the fuel channels is described. The gage basically measures the pressure between two flow impedances; the first, a fixed orifice, and the second the flow impedance of the fuel channel. This type of instrument is well suited to measuring variations in flow impedance with the optimum sensitivity occurring when the pressure between the two impedances is the average of the inlet and outlet pressure of the system. The air impedance gage uses the same principle of measuring the intermediate pressure by means of a diaphragm which varies the flow area of a constant pressure flow meter in an independent flow system. It must be emphasized that the flow through the channel being measured is neither at constant pressure nor at constant flow. (auth)

606 LIMITING CONDITIONS FOR THE RECIRCULATION OF A LIQUID IN A VAPOR-GENERATING LOOP. Kuznetskii, R. S. High Temp. (USSR) (Engl. Transl.); 12: No. 3, 605-607 (1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 691-693 (1974).

The circulation mass flow rate of the liquid, the number of recirculating passes, and the volumetric vapor contents are the principal criteria of the quality of cooling in vapor-generating loops. These parameters, obtained in a calculation under various assumptions, agree with those obtained with a complete hydraulic computer calculation. (PMA)

607 THERMAL DISEQUILIBRIUM IN A STEAM–WATER FLOW. Grachev, N. S.; Ivashkevich, A. A.; Prokhorova, V. A.; Fetisov, M. N. High Temp. (USSR) (Engl. Transl.); 12: No. 3, 593-594(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 680-681 (1974).

The thermal disequilibrium in steam-water flow at the exit from a direct-flow steam generator was studied. Under the established experimental conditions, the steam-water flux was found not to be in thermal equilibrium, and consisted of a mixture of superheated steam and droplets of water, whose temperature was close to the saturation point. The reason for the disequilibrium is that the heat from the wall is transmitted mainly to the vapor in the transcritical zone of a direct flow generator, and is then transmitted by the steam to the drops of liquid. The relatively slow evaporation of the liquid drops results in substantial superheating of the steam (by some tens of degrees). The results are readily explained in terms of water droplets in the flow of superheated steam. (PMA)

608 HIGH SPEED TWO-PHASE FLOW. I. Theory of Axial Change of Flow Parameters and Critical Flows. Adachi, H. (Japan Atomic Energy Research Inst., Ibaraki). Heat Transfer–Jap. Res.; 3: No. 4, 75-88(1974).

A new theoretical method for analyzing two-phase flashing flow is proposed. Two independent energy equations were used: one related to a unit flowing mass of the two-phase mixture and the other to its unit existing mass. This method can be applied to any one-component, two-phase flow, from sub-critical to super-critical, provided the following basic assumptions are satisfied: one-dimensional flow; steady flow; adiabatic flow; gravity force is negligible; and thermally saturated flow. Two-phase critical flows can be determined as a maximum mass velocity flow, corresponding to the conditions dictated by the high pressure reservoir tank. Numerical calculations of the critical parameters show good agreement with experimental information. (auth)

609 HIGH SPEED TWO-PHASE FLOW. II. Flashing Flow Through a Converging–Diverging Nozzle. Adachi, H.; Yamamoto, N. (Japan Atomic Energy Research Inst., Ibaraki). Heat Transfer–Jap. Res.; 3: No. 4, 89-102(1974).

A series of two-phase flashing-flow experiments with a converging-diverging nozzle were performed. The throat diameter of the test nozzle was 10 mm, and the nozzle length 200 mm. The maximum pressure of the reservoir was 30 kg/cm^2-G, and the quality of the steam was in the range 0.0 to 0.51 (calculated from volume-, mass- and energy-balances of the reservoir, on the assumption of thermodynamical equilibrium). The reservoir pressure, discharge flow rate and the distributions of pressure, fluid temperature and mass velocity along the test nozzle axis were measured. The experimental results can be summarized as follows: the observed discharge flow rate is smaller than the value calculated with the saturated flow model, except in the range of quality below 0.01; and the fluid temperature in the test nozzle was about 50°C lower than the saturated temperature, except in the regions near the inlet and outlet. These results indicate that non-equilibrium phase changes occur in the presently investigated converging-diverging nozzle. (auth)

610 ASPECTS OF HEAT TRANSFER IN TWO-PHASE GAS–LIQUID FLOW. Semeria, R. (CEA, Grenoble, France); Hewitt, G. F. pp 319-383 of Heat Exchangers: Design and Theory Sourcebook. Afgan, N. H. (ed.). New York; McGraw-Hill Book Company (1974).

Heat transfer in gas-liquid flow is discussed in terms of: the fundamental aspects of boiling–including nucleate, pool, channel, and crossflow boiling; burnout; condensation; and methods for predicting the performance of heat transfer equipment. (LCL)

611 ASPECTS OF TWO-PHASE GAS–LIQUID FLOW. Hewitt, G. F. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Semeria, R. pp. 265-317 of Heat Exchangers: Design and Theory Sourcebook. Afgan, N. H. (ed.). New York; McGraw-Hill Book Company (1974).

A wide range of topics related to current research on liquid-gas flow is reviewed, and the relevance of these topics to the design of heat exchangers is discussed. Information is included on flow patterns; system variables; mathematical models for parallel flow and non-parallel flow; critical two-phase flow; unsteady flow; and types of two-phase flow equipment used in industry. (LCL)

612 ESR STUDIES OF TRIPLET RADICAL PAIRS OF CO_2^- IN IRRADIATED SINGLE CRYSTALS OF $CH_3COOLi{\cdot}2H_2O$. Nunome, K.; Toriyama, K.; Iwasaki, M. (Government Industrial Research Institute, Nagoya, Hirate, Kita, Nagoya, Japan). J. Chem. Phys. 62: No. 8, 2927-2933 (15 Apr 1975).

Single crystals of $CH_3COOLi{\cdot}2H_2O$ irradiated at 77 °K gave ESR signals arising from triplet radical pairs in addition to CH_3 radicals. Spectral analyses lead to the conclusion that a pair of CO_2^- ions are formed with the average separation of 5.95 Å. The unpaired electrons extend over the four neighboring Li cations giving 13-line superhyperfine structures. Strong nuclear spin forbidden transitions arising from the anisotropic coupling with ^{7}Li nuclei were observed in one of the fine structure components. From this behavior the sign of the isotropic coupling of ^{7}Li was determined to be positive. The structure and the trapping site of the paired CO_2^- ions interacting with Li were elucidated from the g and D tensors as well as the ^{7}Li and ^{13}C hyperfine coupling tensors. The isolated CO_2^- ions in the crystals annealed at room temperature have been found to undergo hindered oscillation around the O···O axis at 77 °K. As a very minute component the radical pairs of $CH_2CO_2^-$ were also found in the crystal stored at 77 °K after irradiation. (auth)

613 ESR SPECTRA OF THE CARBOXYLATED CYCLOHEXADIENYL RADICALS: ^{13}C HYPERFINE CONSTANTS AND THE EFFECT OF CARBOXYLATION ON THE g FACTORS AND PROTON HYPERFINE CONSTANTS. Eiben, K.; Schuler, R.H. (Radiation Research Laboratories and Department of Chemistry, Mellon Institute of Science, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 8, 3093-3108 (15 Apr 1975).

The *g* factors and proton hyperfine constants of 15 multiply carboxylated cyclohexadienyl radicals and all 19 of the carboxylated hydroxycyclohexadienyl radicals have been determined by the *in situ* radiolysis method. The *g* factors were measured with sufficient accuracy (±0.00002) to establish that they increase monotonically with total spin density on the positions substituted. The proton hyperfine data are interpreted to indicate that there is a 13% loss in spin density on the ring in the pentacarboxylate radical. Pronounced effects of asymmetric substitution are noted even when this substitution is at a

position of low spin density. For the more highly charged hydroxycyclohexadienyl radicals the ESR spectra are sufficiently intense that the ^{13}C containing radicals can be observed at the natural abundance level. Complete sets of ^{13}C hyperfine data are reported for the 1,3,5-tricarboxylate, the three tetracarboxylate and the pentacarboxylate radicals. Definitive assignment of ^{13}C hyperfine constants to the carboxyl groups attached to the conjugated system is possible. Values of 4.8, 1.3, and 6.8 G are attributed to positions 1, 2, and 3, respectively, in the pentacarboxylate radical. These hyperfine constants parallel almost exactly the proton values in the unsubstituted radical so that one can conclude that they can be used as a good indicator of the spin density on the adjacent ring carbon via a relation of the form $a^C(CO_2^-) = Q^C(CO_2^-)\,\rho_n$. Correlation of the ^{13}C and proton hyperfine data give a value of 15.8 G for $Q^C(CO_2^-)$. Ring ^{13}C hyperfine constants of ~ 18, 12(2), 11(2), and 8.5 G are observed for each radical with the largest and smallest values being assigned, respectively, to the carbon atoms at positions 3 and 6. Comparisons among the different sets of values indicate variations from predictions based on the Karplus–Fraenkel treatment of the order of 10% so that specific assignment of the remaining four values is difficult. The hyperfine constants of the methylene protons in the substituted cyclohexadienyl radicals reflect very closely the loss in spin density to the carboxyl groups. Substitution in the hydroxycyclohexadienyl radicals, however, produces a far more pronounced and complicated effect that indicates a strong interaction between the OH group and the carboxyl groups substituted on the adjacent positions. (auth)

614 SIMULTANEOUS RADIATIVE AND CONVECTIVE HEAT TRANSFER IN A PACKED BED WITH HIGH POROSITY. Echigo, R.; Hasegawa, S.; Nakano, S. (Kyushu Univ., Japan). Heat Transfer - Jap. Res.; 3: No. 4, 1-12(1974).

The simultaneous radiative and convective heat transfer in a circular tube packed with fibrous or sintered material for the purpose of enhancing the heat transfer characteristics for high-temperature systems is analyzed. The momentum equation, which involves the drag by the packed media, is solved analytically and the solution of energy equation, taking account of thermal radiation, is obtained by a numerical procedure. Subsequently the heat transfer characteristics are evaluated and the heat transfer mechanism is examined in some detail. In consequence, this system shows excellent heat transfer which is attributed to the absorption of radiation by the packed media, provided that the optical depth of medium is appropriate. (auth)

615 COMPUTER CODES IN NATURAL CONVECTION. Drut, R.; Mejane, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 61-68(Nov 1974). (In French).

The computer codes CONCYL and ESPAN were established to solve some problems in natural convection in enclosures, particularly in nuclear reactors structures and component studies. The CONCYL code deals with natural convection in a bidimensional axisymmetric space in laminar flow. The ESPAN code solves bidimensional equations with energy sources and vortex. It allows to predict cellular movements developed in annular spaces. The use of these codes is not limited to reactor studies: they may be useful in many other fields. (FR)

Materials Testing

Refer also to abstracts 427, 430–432, 1005, and 1302.

616 (BNWL-839) PROTOTYPE ULTRASONIC THICKNESS TEST FOR NbC COATING ON NbC-GRAPHITE COMPOSITE. Fitch, C. E. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1968. Contract AT(45-1)-1830. 41p. Dep. NTIS $5.25.

Declassified 28 Aug 1973.

Results of the feasibility study devoted to exploratory investigations of an ultrasonic critical angle technique for measuring the thickness of niobium carbide coatings on niobium carbide-graphite substrates for a thickness range of 0.001 to 0.005 in. are described. A two-transducer ultrasonic instrument was developed and applied to coated test samples supplied by LASL, which ranged in thickness from about 0.0025 to 0.007 inches. The range span of the tester is adjustable to cover other ranges of interest. (auth)

617 (WANL-TMI-533) LOCKING DEVICE FOR CLUSTER ATTACHMENT. Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Feb 1963. 3p. Dep. NTIS $4.00.

Locking cups were crimped into the flats of "finger-tight" hex-head nuts by the use of a crimping tool. The "break-away" torque required to overcome the crimp on the hex nuts or to shear the locking tab in the locking cup were measured and are tabulated. (LCL)

618 (WANL-TMI-886) TENSILE PROPERTIES OF TIE RODS. Part No. 944C732, Spec. Grade. Request No. 240; Request No. 257. Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Dec 1963. 7p. Dep. NTIS $4.00.

Fifteen tie rods from each of two heats were submitted for tensile tests. Tests were conducted in the Wiedemann Testing Machine. An autographic load/strain curve was obtained from each tie rod using a 2 inch extensometer clamped to the test rod at mid-length. Tests were at ambient temperature and atmosphere. The tensile data for the two heats are tabulated. Although uniformity of both heats is quite good and well within specifications, one heat exhibited slightly more variations in both strength and ductility. (auth)

619 (WANL-TMI-1701) PYRO SLEEVES (EML-67). Parsons, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Aug 1966. 5p. Dep. NTIS $4.00.

Room temperature compression strength tests on five pyrolytic graphite insulating sleeves are reported. Data on the deflection of an assembly of five sleeves under loads from 0 to 35 lb. and from 0 to 332 lbs. (failure point) are presented. (LCL)

620 UNIVERSAL PORTABLE TRIPOD FOR THE MODEL IRA-ID X-RAY EQUIPMENT AND THE CESIUM 2-1 GAMMA RADIOGRAPHY EQUIPMENT. Vainshtein, I. B.; Panchenko, A. T. (Main Isotope Lab., Donetsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 480-481(1974).

Translated from Defektoskopiya; 10: No. 4, 125-127(1974).

Under industrial conditions, various units and components of machines and mechanisms being tested are subjected to radioscopy at various heights and at all angles. A universal, portable tripod which enables the x-ray unit and the radiation head to be adjusted to various heights, and which is convenient for carrying, is described. (auth)

621 ACCURACY IN JOINT MEASUREMENT OF THICKNESS AND ATOMIC NUMBER VIA BACK-SCATTERED GAMMA RAYS. Troitskii, I. N. Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 424-431(1974).

Translated from Defektoskopiya; 10: No. 4, 63-72(1974).

The range of accuracy for simultaneous measurement of the thickness and atomic number is examined when the second is determined from the shape of the soft part of the scattered gamma-ray spectrum. A method is given for defining the optimal radiation spectrum to be used for the joint measurement. (auth)

622 TELEVISION-TYPE GAMMA-RAY FLAW DETECTOR. Gromov, Yu. V.; Smirnov, O. P.; Leonov, B. I. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 417-420(1974).

Translated from Defektoskopiya; 10: No. 4, 54-59(1974).

A description is given of a closed-circuit television system for working with ^{60}Co; tests with the Rad gamma equipment are reported. (auth)

623 METHOD OF RADIOMETRIC FLAW DETECTION. Serebrennikov, I. Ya.; Sul'kin, A. G. Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 421-423(1974).

Translated from Defektoskopiya; 10: No. 4, 59-62(1974).

A description is given of a radiometric flaw detector that enables one to eliminate the effects of surface relief on the resolving power in examining internal defects and to determine the depth of the defect. This is attained by irradiating the part at an acute angle to the surface, together with the use of a source-detector or component system in rotation. It is shown that this substantially reduces the extent of the information about the surface relief. (auth)

624 TRANSFORMATION FOR A NONSTATIONARY POISSON FLUX OF PULSES OF RANDOM AMPLITUDE. Gorbunov, V. I.; Zav'yalkin, F. M.; Kvasnitsa, M. S. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 413-416(1974).

Translated from Defektoskopiya; 10: No. 4, 49-54(1974).

A statistical description is given of the response of a radiometric device to a nonuniformity in the moving absorber; the convergence to a normal distribution is examined. Examples are given of calculation of the response for several forms of useful signals. (auth)

625 SYSTEMATIC ERROR IN RADIOMETRIC MONITORING OF HOLLOW CYLINDERS. Pokrovskii, A. V.; Malofeev, B. I. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 4, 407-412(1974).

Translated from Defektoskopiya; 10: No. 4, 43-49(1974).

An analysis is presented for the systematic error arising from

vibration of a hollow cylinder during radiometric monitoring. A rigorous solution is obtained for the equation describing the vibration error. The contribution from this error has been calculated as a function of the radius, thickness, collimator area, and focal distance. A nomogram has been constructed for evaluating this error. (auth)

626 REMOTE MEASUREMENT OF PRINCIPAL ELEMENTAL CONCENTRATION AND ELECTRONIC DENSITY IN DENSE BODIES. Walford, G. V. (Eelectronic Associates of Canada, Downsview, Ont.); Fenton, T. R. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 428-436(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

It is of value in given instances to be able to determine the variation of principal element concentration and electronic density in a body. Such measurements have application in medical and industrial areas. This paper describes a technique for undertaking such measurements. Preliminary data are presented which indicate the plausibility of the technique using high resolution detectors. Further work is required to fully evaluate and develop the technique. (auth)

627 NDT FOR IRRADIATED REACTOR FUEL PINS BY EDDY CURRENTS AND GAMMA SCANNING. Prestwood, J.; Sumerling, R. (United Kingdom Atomic Energy Authority, Sellafield). Non-Destruct. Test. (Guildford, Engl.); 8: No. 2, 90-93(Apr 1975).

A combined technique incorporating eddy-current testing and total γ scanning to examine irradiated fuel pins from water-cooled reactors is described. This NDT technique is for fuel pins 3 to 4 m long and gives information on both cladding and fuel. The eddy-current testing not only detects any defects in the cladding including hydride concentration in Zircaloy but also estimates the size of small circumferential ridges in the cladding which form at the ends of the UO_2 pellets during irradiation. The total γ scan measures shrinkage of the fuel stack and the formation of any gaps between pellets. The simultaneous use of both methods gives additional information on interaction between the fuel and its cladding which is useful if the behavior of fuel pins is to be understood. (auth)

628 IMPROVED READING OF RADIOGRAPHIC IMAGES BY ISODENSITOGRAPHIC ANALYSIS. Blanc, J. (Agfa-Gevaert, 92 - Rueil-Malmaison (France)). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 107, 5-7(May 1974). (In French).

Various methods have been proposed to maintain a high degree of perceptibility during as large an irradiation amplitude as possible. An original solution has been found with Agfa Contour Film. It involves two emulsions, a blue-sensitized positive and a green-sensitized negative. A yellow filter varies the sensitivity of the positive emulsion towards the negative. At maximum filtration the two sensitivity curves meet and form a V, and from a radiographic plate it is possible to extract only the zone of density corresponding to this internal. A series of isodense lines is thus obtained and the signals on either side of the isodense bands are copied with a considerable amplification factor (12 for the negative and 20 for the positive curve). The perceptibility is greatly improved. This method has been applied in various sectors of industrial and medical radiography. (FR)

629 POSSIBLE UTILIZATION OF ACOUSTIC EMISSION FOR NONDESTRUCTIVE TESTING OF WELDS AND WELDED STRUCTURES. Hart, S. D. Soudage Tech. Connexes; 28: No. 11, 506-510(Nov 1974). (In French).

The principal characteristics and applications of acoustic emission are reviewed: emission sources, signals, weld testing, pressure vessel testing and pipe line inspection. The equipment (tranducers, amplifier and signal processing equipment) is described and the difficulties arising from the various electronic interferences are discussed. (FR)

630 A PRODUCT FOR USE IN NEUTRON RADIOGRAPHY. Barbier, F. F. L. P.; Renard, G. J. A. (to Societe Kodak-Pathe). French Patent 2,203,109/E/. 10 Sep 1971. 8p. (In French).

The product comprises a recording layer preferably consisting of a transparent film of cellulose nitrate and on each surface a conversion layer made of a lithium salt dispersion in a water-soluble binder. The product improves the sensitivity and contrast for use in neutron radiography. (FR)

631 DETERMINATION OF THE CONDITIONS OF ^{170}Tm RADIOGRAPHY OF TUBE WELDS ON PLATE AND TUBE JOINING WELDS. Samman, J.; Compagnon, B. (Societe Babcock-Atlantique, 44 - Saint-Nazaire (France)). Bull. Inform. A.T.E.N. (Ass. Tech. Energy. Nucl.), Suppl.; No. 107, 8-17(May 1974). (In French).

An account is given of tests carried out on a 45MW sodium steam generator. The welds radiographed were of 3 types: tubes welded to plates; connecting welds of the thermal sleeve to the sleeve tube; and tube welds. The welding of tubes to plate was checked with a ^{170}Tm source placed inside the tube which gave a long exposure time. Volume defects and lack of penetration depth were enlarged but certain small defects were not detected. For tube welds, a ^{170}Tm and a ^{192}Ir source were used. (FR)

Nuclear Explosions

Refer also to abstracts 745, 777, 947, and 1511.

632 (AD-778493) SPECIAL EVENT DETECTION FOR AN UNATTENDED SEISMIC OBSERVATORY. Final Technical Report, 15 March-14 November 1973. Eterno, J. S.; Burns, D. S.; Freier, L. J.; Buck, S. W. (Draper (Charles Stark) Lab., Inc., Cambridge, Mass. (USA)). Mar 1974. 79p. (AFOSR-TR-74-0585). NTIS $4.00.

A practical event detection system for monitoring remote three-axis seismometers is described. The self-contained system, through use of digital storage, records data from 30 seconds before an event is triggered until earth motion subsides. Intended for use in an unmanned seismic observatory, the device is capable of detecting near events as well as the multiple phases of teleseisms. Provision has been made for the on-site adjustment of critical detection parameters. A prototype has been tested on prerecorded data at the VELA seismological center in Alexandria, Virginia. A summary and interpretation of the test results is included. (auth)

633 (AD/A-000582) ELLIPTICITY FILTER: A PROPOSED SOLUTION TO THE MIXED EVENT PROBLEM IN NUCLEAR SEISMIC DISCRIMINATION. Quarterly Technical Report No. 1, 1 April 1974-30 June 1974. Posmentier, E.; Gershman, R.; Harris, B. (Ocean and Atmospheric Science, Inc., Dobbs Ferry, N. Y. (USA)). 7 Sep 1974. 41p. (OAS-TR-74-232; AFOSR-TR-74-1640). NTIS $3.75.

A proposed solution to the Mixed Event problem in nuclear seismic discrimination, termed the "ellipticity filter," is cast in the form of a solution of the superposition equations defining the signals from a three-component seismometer station. Two cases of superposed signals are considered: Rayleigh with Rayleigh and Rayleigh with Love. Using the ellipticity constraint at the seismometer station site, the superposition equations defining each case are solved in closed form to yield the unknown complex source amplitudes and source azimuths. Actual filter procedure involves dividing the component signals into time intervals, taking the fourier transform for each time interval, and operating on each of the frequency components in a time interval with the ellipticity filter. (auth)

634 (AD/A-001909) GEOSCIENCES BULLETIN. Series A, Volume 3, October-November 1972. Shishkevish, C. (Rand Corp., Santa Monica, Calif. (USA)). 1972. Contract DAHC15-67-C-0141. 164p. Rand Corp., Santa Monica, CA 90406, $4.00.

The current issue of the Geosciences Bulletin consists of a single account of the Soviet network of seismographic stations. A forthcoming Rand report will provide further, up-to-date information on the network of stations and will deal analytically with the most recent developments in seismic instruments, seismic arrays, and related subjects. (GRA)

635 (AD/A-001910) GEOSCIENCES BULLETIN. Series A, Volume 3, December 1972. Shishkevish, C. (Rand Corp., Santa Monica, Calif. (USA)). 1972. Contract DAHC15-67-C-0141. 53p. (R-1042/12/ARPA). Rand Corp., Santa Monica, CA 90406, $3.00.

The contents of the report are as follows: crustal and upper mantle structure from seismological data; deep seismic sounding; degrees; density distribution; detection of underground nuclear explosions; earthquake parameters; earthquake prediction; effects of explosions; equations of state; methods and techniques of interpreting seismological data; microseisms and seismic noise; seismic modeling; seismic sources and focal mechanism investigations; seismicity; seismic waves; seismological aspects of volcanic activity; shock waves in solids; structure of the earth's interior below the upper mantle; theoretical seismology; and underground nuclear explosions. (GRA)

636 (AD/A-002252) PROGRESS REPORT, NORSAR PHASE 3. Quarterly Report No. 3, 1 July-30 September 1974. Berteussen, K. A. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 23p. 11 Oct 1974. NTIS $3.25.

The operation and research activities at the Norwegian Seismic Array (NORSAR) in the period 1 July to 30 September 1974 are discussed. The performance of the field instrumentation and computer installations was stable with a normal amount of corrective maintenance. The ARPANET terminal is used routinely

for data exchange. In the event processor a new program package, which will calculate optimal beamforming weights for some selected unclear detections, is in progress. In the detection processor a floating threshold procedure is in development. In connection with this a study of the seasonal and diurnal noise variance fluctuations and their effect on earthquake detectability was finished. It was shown that the short-periodic seismic noise at NORSAR can be described by autoregressive models. (GRA)

637 (AD/A-002336) RESULTS OF GROUND MOTION AND AIRBLAST MEASUREMENTS, PROJECT ESSEX 1, PHASE 1, VOL. 1 AND 2. Vortman, L. J.; Beyeler, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1974. Contract AT(29-1)-789. 241p. (SLA-73-0918; DNA-PR-0006). NTIS $7.50.

Four high-explosive charges were detonated in saturated soil to simulate employment of atomic demolition munitions. Two 10-ton charges were buried 12 m deep, one stemmed and one with a small open hole; one 10-ton stemmed charge and one 8 5-ton unstemmed charge were at 6 m. On each shot instruments measured shock propagation above the charge, shock stress, and ground acceleration at one position at half-shot depth and at three shot-depth positions, ground-surface acceleration at four to five positions, shock pressure in the open holes of the unstemmed shots, and above-ground airblast at several distances. Ground-surface displacement was measured with high-speed photography. Peak stresses ranged from 0.05 to 3 kbars. These measurements were made to provide information on effects of charge burial depth and stemming, as well as physical data that could be used to verify the hydrodynamic codes being used for numerical simulation of ADM explosions. (GRA)

638 (AD/A-002445) QUARTERLY TECHNICAL SUMMARY REPORT, JULY-SEPTEMBER 1974. Progress Report. Hartenberger, R. A. (Teledyne Geotech, Alexandria, Va. (USA)). 15 Oct 1974. Contract F08606-74-C-0006. 12p. (SDAC-TR-74-20). NTIS $3.25.

A summary is presented of the technical work accomplished at the Seismic Data Analysis Center (SDAC) during the third quarter of 1974. Part A summarizes the seismological findings which were approved for distribution during the period. Part B describes system development work associated with the expanded VELA network, and part C is a review of accomplishments within the operating systems at the SDAC. (GRA)

639 (AD/A-002496) AMPLITUDE PATTERN EFFECTS ON NORSAR P-WAVE DETECTABILITY. Berteussen, K. A.; Husebye, E. S. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 20 Nov 1974. Contract F08606-74-C-0049. 53p. NTIS $4.25.

A detailed mapping of NORSAR P-wave amplitude anomalies as a function of the array's beam locations was performed. For several regions there is as much as 20 db amplitude variations across the array. There is, however, usually less than 0.3 db to gain in signal-to-noise ratio by excluding one or more of the NORSAR subarrays. Moreover, one will have to use very small regions, i.e., one set of weights for each of the detection processor beams. This is because the amplitude pattern, although stable for events coming in on the same beam, may change very drastically from one beam location to the nearest one. (GRA)

640 (AD/A-002660) NEW APPLICATIONS OF GROUT AND CONCRETE AS SHOCK IMPEDANCE MATCHING MATERIALS FOR GEOLOGIC FORMATIONS. Final Report. Ainsworth, D. L. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). Apr 1972. 59p. NTIS $4.25.

New applications of grout and concrete along with supporting studies and experimental techniques are reported. These new applications are in support of underground nuclear weapons testing. Grouts and concretes are designed and tested to respond to a high-pressure shock environment in the same manner as the in situ formation. This is quantitatively described by the equation of state of the materials at high pressures and the constitutive relations at lower stresses. Several typical matches in the equation-of-state plane are presented, which represent work done in support of the various weapons test events. (GRA)

641 (AD/A-003097) SEISMIC WAVES DURING UNDERGROUND NUCLEAR EXPLOSIONS. Rodionov, V. N.; Kostyuchenko, V. N.; Sultanov, D. D. 20 Nov 1974. Translated from pp 3-24 of Seismicheskie Volny pri Podzemnykh Yadernykh Vzryvakh, Moscow, 1971. (FTD-HC-23-2413-74). 25p. NTIS $3.25.

The general problem of providing seismic safety during underground nuclear explosions can be dividied into the following special problems: (1) forecasting the main parameters of seismic waves as a function of the yield and depth of the explosion, the distance from the point of the explosion, and the geological conditions both in the region of the explosion and along the path of the seismic waves at the location of buildings and structures; (2) based on the predicted values of the main parameters of seismic waves, assessment of the possible effect of the waves on buildings and structures with regard to the type, design and condition of the building; and, (3) determination of the required measures to provide seismic safety, including determination of the maximum permissible yield of the explosion. (GRA)

642 (AD/A-003220) GROUND MOTION CALCULATIONS FOR THE MIXED COMPANY EVENT OF THE MIDDLE NORTH SERIES. Final Report. Sandler, I. S.; Wright, J. P.; Baron, M. L.; Kovarna, J. (Weidlinger Associates, New York (USA)). Oct 1974. Contract DACA39-72-C-0002. 212p. (AEWES-CR-S-74-4). NTIS $7.25.

A series of calculations of the Mixed Company event was performed using the Weidlinger Associates layer code. The calculations incorporated preshot and postshot models obtained jointly by Weidlinger Associates and the Waterways Experiment Station. The results of the postshot computations are presented and compared to the measured field response and to the preshot calculations. Although the postshot results are in slightly better agreement with the field data than were the preshot results, there remains considerable disagreement between all the computations and the data, especially as far as outrunning and crater-induced motions are concerned. Possible explanations for the discrepancy and recommendation studies to correct them are presented. (GRA)

643 (AD/A-003388) PRELIMINARY REPORT ON PROJECT GAS EXPLOSIVE SIMULATION TECHNIQUE. Final Report, November 1972-February 1974. Bigoni, R. A.; Matuska, D. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Oct 1974. 128p. (AFWL-TR-74-252). NTIS $5.75.

The Air Force Weapons Laboratory (AFWL) fielded a series of experiments to simulate low-altitude nuclear fireball phenomenology. Thirty-two-foot diameter gas containers were filled with a near-stoichiometric mixture of CH_4 and O_2 and were detonated with yields equivalent to approximately 1500 lb. of TNT. The Reynolds number describing the motion of the resulting hot gases was high enough so that the motion of the gases was dynamically similar to that in a nuclear fireball. (GRA)

644 (FOA-C-20043-T1) EVASION BY HIDING IN EARTHQUAKE. Jeppsson, I. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1975. 35p. Dep. NTIS (US Sales Only) $4.75.

An analysis was made of the possibility of concealing the seismic signals from an underground explosion in the signals from an earthquake in the same area. The signal amplitude as a function of time was studied for earthquakes from different regions. By means of a simulation experiment the required magnitude difference between the earthquake and explosion is estimated, as well as its dependence on the difference in signal onset times. From this experiment and seismicity studies, the number of detonation opportunities per year in three regions in the U. S. and the USSR is calculated. Assuming in advance that the device is placed at a defined point, the result is that the opportunities are few, i.e., one or less than one per year in the three studied regions for an explosion with an expected m_b of 4.5. (auth)

645 (JPRS-63502) PEACEFUL NUCLEAR EXPLOSIONS AND THE ENVIRONMENT. Izrael, Yu. A. 22 Nov 1974. Translation of Mirnye Yadernye Vzryvy i Okruzhayushchaya Sreda, Leningrad, 1974. 146p.

Data on various peaceful uses of underground nuclear explosions for engineering, excavation and scientific studies are presented. (GRA)

646 (SAND-74-0066) AIRBLAST MEASUREMENTS, PROJECT DIAMOND ORE, PHASE IIB. Vortman, L. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1975. Contract AT(29-1)-789. 186p. Dep. NTIS $12.50.

Airblast measurements were made with two gages at each of three separate distances from the 20 cratering shots of Project Diamond Ore, Phase IIB. There were seven unstemmed single-charge shots, three unstemmed row-charge shots with three charges, three stemmed row-charge shots with five charges, two stemmed row-charge shots with three charges, and four shots with charges at or near the ground surface. Weights of individual charges ranged from 80 to 34,000 lbs. The unstemmed single-charge shots varied in depth of burial and permitted the attenuation of airblast parameters to be defined as a function of these depths. No comparison of the stemmed row-charge airblast with that from stemmed single charges was possible because no single charges have been fired in the same medium. No comparison was made for single-and row-charge unstemmed detonations because of differences in explosive, charge size, charge burial depth, and open-hole diameter. Differences in airburst from surface and near-surface bursts resulting from variances in charge position were less than differences caused by meteorological changes on the days the shots

were fired. The single-charge data provided a further opportunity to evaluate the usefulness of airburst suppression with charge burial depth and stemming as an analog to suppression of radioactivity from nuclear cratering explosions. Airblast gas-venting impulse fractions out of the ground were in agreement with those obtained on one shot for radioactivity fraction using a radioactivity simulant. Airblast as an indicator of suppression has the advantage of being less dependent on local wind conditions. (auth)

647 (UCID-16762) RIO BLANCO GAS COMPOSITION. LLL Data Summary: Calibration and Production Testing of RB-AR-02, November–December 1974. Smith, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1975. Contract W-7405-eng-48. 36p. Dep. NTIS $5.00.

The chemical composition and radionuclide concentration of Rio Blanco chimney gas samples collected during calibration and production testing of the RB-AR-02 well are presented. A brief summary of the analytical procedures used, and of their attendant uncertainties are provided in conjunction with a description of the conventions adopted for the data presentation. Analytical data, as presently available, are included for each sample received for processing by LLL. Sufficient additional information is included to permit the reader to associate the analytical data with the progress of well testing operations. (auth)

648 PEACEFUL NUCLEAR EXPLOSIONS. Kruger, P.; Despois, J.; Sarda, J. P.; Nougarede, F. Trans. Amer. Nucl. Soc.; 20: 792-793(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

649 EARTHQUAKE SIMULATION BY NUCLEAR EXPLOSIONS. Kolar, O. C.; Pruvost, N. L. (Univ. of California, Livermore). Nature (London); 253: No. 5489, 242-245(24 Jan 1975).

The distinguishing of a clandestine nuclear test as a natural earthquake by detonating a sequence of explosions, one of which would be caused by the device of interest, is discussed. Such a disguise might be attempted by a country wishing to evade a comprehensive test ban treaty. (auth)

650 PROJECT ORION. Gatland, K. W. Spaceflight; 16: No. 12, 454-455(Dec 1974).

Project Orion is a research program for a nuclear pulse rocket conducted for the US Department of Defense more than a decade ago. A brief history of the project is given, but it is pointed out that much of the project is still highly classified. The idea is to employ low-yield nuclear bombs as propulsion devices. A major problem, however, is that of radioactive contamination during flight of the rocket through the atmosphere. (UK)

651 FRICTION AND BEARING LOADS ON BURIED PIPES. Blake, A.; Zaslawsky, M. (Lawrence Livermore Lab., CA). Soc. Petrol. Eng. J.; 13: No. 3, 163-174(Jun 1973).

Results of experimental and theoretical investigations of the behavior of downhole pipe, surrounded by Overton sand or gravel, when subjected to shock from a nuclear explosion are presented. The principal effects investigated are (1) longitudinal friction between the pipe and the stemming material and (2) resistance offered by the stemming material to transverse motion of the pipe. (auth)

Protective Structures and Equipment

Refer also to abstracts 413, and 657.

652 (AED-CONF-74-555-001) USE OF "STARS" NUMERICAL INTEGRATION CODES FOR THE SOLUTION OF COMPLEX SHELL PROBLEMS. Svalbonas, V.; Ferdie, R. D. 1974. 25p. INIS.

From finite element congress–case studies and new developments; Baden-Baden, F. R. Germany (18 Nov 1974).

The basic STARS shell of revolution analysis codes have been utilized to analyze many complex shell structures since their first applications in the design of the Lunar Module (LM) in the early 1960's. The applications have included submersibles, rockets, engines, pressure vessels and containment, antennae, and buildings. This presentation will concentrate on three sample applications, chosen to exemplify both ease of use and present range of capabilities. To justify the general use of the STARS codes for shell of revolution analysis, the capabilities of the STARS segment model will be briefly compared with an ordinary revolved finite element model. This comparison will be made both on a theoretical basis and continued through the example problems. (GE)

653 (KLX-1842) E-MAD FACILITY. Phase I. Nuclear Shielding Report. Reiback, E. M.; Hellman, S. K. (Vitro Engineering Co., New York (USA)). 1 Apr 1963. 116p. Dep. NTIS $9.00.

The E-MAD engine maintenance and disassembly facility was built to provide a shielded building for the maintenance and examination of NERVA and Phoebus nuclear rocket engines after engine testing at full power. The following information is presented on the E-MAD facility: design criteria; shielding capability; dose rates in nearby areas from the engine as it is transported to disassembly bay; radiation monitoring; and testing of the shielding walls. (LCL)

654 (WANL-TME-2796) ANALYSIS OF NUCLEAR WEAPON INITIAL RADIATION SHIELDING EFFECTIVENESS IN THE OCD-DIDS TRANSMITTER FACILITY. Dickson, P. W. Jr.; Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Oct 1971. 35p. Dep. NTIS $4.75.

The analysis confirms the radiation safety of this facility. Occupants would not receive a dose of more than 20 rem from initial neutron and gamma radiation in the event of a nuclear attack. (TFD)

655 SLEEVELET, OR SLEEVE, FOR GLOVES, BAGS AND THE LIKE USED FOR MANIPULATIONS WITHIN TIGHTLY SEALED ENCLOSURES. Segonzac, J. M.; Lucas, J. M. (to Piercan, le Latex de France). French Patent 2,195,510/A/. 10 Aug 1972. 10p. (In French).

The sleevelet for gloves, bags or similar members for manipulations within tightly-sealed enclosures comprises a circular end-flange and a body opposite that flange. The sleevlet is characterized in that it comprises an annular portion for connecting the end-flange to the body, said portion showing a substantial abrupt increase in diameter in the immediate vicinity of the flange, then becoming narrower before joining the member body. The invention makes it easy matter to exchange a glove for another without impairing the enclosure tightness, while preventing the new glove from being a hindrance to the worn glove removal. (FR)

656 THE ROLE OF LEAD IN THE DESIGN AND BUILDING OF NUCLEAR SHIELDING. Seran, R.; Vertut, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). Mater. Tech.; No. 11, 481-486(Nov 1974). (In French).

Lead has an important application in nuclear industry (radiation protection). The lead shielding used (hot cell components, transport containers) and the homogeneity tests carried out on the lead are described. (FR)

Safety Engineering

Refer also to abstracts 652, 1096, 1119, and 1569–1572.

657 (TID/SNA-1444) LIQUID ROCKET PLANT SAFETY PROGRAM RELATIVE TO NERVA OPERATIONS. Report No. 2783001. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Sep 1963. 97p. Dep. NTIS $8.00.

The liquid rocket safety program under which NERVA operations are conducted is described. The program has been in active existence since 1955 when the liquid rocket plant was established at Sacramento. It is intended that the information supplied herein will provide a description of the program with enough detail to be useful, but does not attempt a complete definition of the safety effort at the liquid rocket plant. (auth)

658 A PROTECTIVE DEVICE AGAINST THE DETRIMENTAL EFFECTS OF THE RUPTURE OF A FLYWHEEL. (to Societe Babcock-Atlantique). French Patent 2,200,906/D/. 26 Sep 1972. 11p. (In French).

A solid annular member mounted around a flywheel rim with a 2.5 mm (0.1 in) clearance is placed inside a ball-bearing fixed ring so as to rotate freely. In the event of a rupture of the flywheel, the latter becomes integral with the annular member and drives it rotatively. Flat rings pressed against the webs of the solid annular member cause the whole system to slow down. The stresses generated by the flywheel/rupture are re-directed to the casing (within which flywheel fragments are confined) in view of the protective member resistance. These flywheels can be used as circulating/pumps for the primary coolant in nuclear installations. (FR)

Vacuum Engineering

659 (IBK-1276) EMA 10 ULTRAHIGH VACUUM SYSTEM. Terzicj, I. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). May 1974. 27p. (In Serbian). INIS.

The ultrahigh vacuum system of the experimental set-up (called EMA 10) is presented. It has been constructed with the aim of studying the low-energy ion interaction with solids. The basic parameters of the vacuum system are: total volume of the system V = 100 liters; and the achieved limit pressure (without baking system) 3.10^{-9} torr. The pumping elements of the system are an ion pump with the rate of pumping of 400 l/s and sorption pumps. (INIS)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 39.

660 (AEC-RID-2) THORIUM, YTTRIUM, AND RARE-EARTH ANALYSES, LEMHI PASS, IDAHO AND MONTANA. Austin, S. R. (USAEC Grand Junction Office, Colo.). Apr 1968. 17p. GJO.

The thorium and rare-earth deposits of Lemhi Pass occur in a more or less continuous northwest-trending zone on both sides of the Idaho-Montana border from North Fork, Idaho to an intrusive granite east of Leadore, Idaho. Host rocks of the thorium veins are quartzite and phyllites of the Precambrian Belt Series. Tertiary volcanic rocks blanket much of the area. The ore deposits are thought to be early Tertiary in age. Over 200 samples were collected from 50 properties in the area. Emission spectrography was the method of analysis. The semiquantitative results of these thorium, yttrium, and rare-earth analyses are given. (ERB)

661 (AED-CONF-74-600-011) URANIUM AVAILABILITY. Houdaille, M. (Uranex, 75 - Paris (France)). 1974. 7p. INIS.

From symposium on natural uranium supply; Mainz, F. R. Germany (18 Nov 1974).

A review is given on estimates of French domestic uranium resources as well as on the results of French exploration efforts abroad. A comparison of three estimates (1970, 1973, and 1974) of the development of nuclear power plant capacities in 1974, 1980, and 1985 is given as well as thus related U_3O_8 demand. The estimates concern the USA and the whole western world. According to these figures, the demand of supplies can be well covered with low costs (<10/lb U_3O_8) of available uranium until 1985. (GE)

662 (DAO-3-TM-39) GEOLOGY OF URANIUM OCCURRENCES IN OR NEAR FLUORITE DEPOSITS IN JACKSON COUNTY, COLORADO. Malan, R. C. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 13 Dec 1956. 13p. GJO.

Uraniferous purple fluorite veins, fluorite-chalcedony cemented breccia pods, and oxidized uranium minerals are localized by Laramide structures in Precambrian granite of the Park Range in the Red Canyon area, western Jackson County, Colorado. Physical control on the emplacement of uranium minerals was furnished by the north-south trending Pedad fault and its related tensional adjustments. Studies carried out as a basis for this report have indicated no commercial concentrations of uranium in this area. Fluorite properties in the Northgate district of northern Jackson County contained from nil to trace amounts of uranium in an unidentified form. (auth)

663 (DAO-3-TM-40) GEOLOGY OF URANIFEROUS PEAT BEDS AT THE SPRING CLAIMS, JACKSON COUNTY, COLORADO. Malan, R. C. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Feb 1957. 17p. GJO.

Springs issuing through alluvial fill near a contact of the Chugwater formation and Precambrian granite at the eastern base of Sheep Mountain, Jackson County, Colorado are relatively high in bicarbonate, calcium, and excess carbon dioxide. This water contains from 75 to 115 parts per billion uranium. Peat beds of limited extent in the vicinity of the springs furnish favorable reducing environments for the precipitation of unidentified uranium minerals from these mineralizing meteoric waters. The composition of these waters suggests that their major movement has been through the calcareous sedimentary formations of Mesozoic age in the North Park structural basin. (auth)

664 (DAO-3-TM-41) GEOLOGY OF THE URANIUM OCCURRENCES IN THE DAKOTA HOGBACK RIDGE, NEAR MORRISON, JEFFERSON COUNTY, COLORADO. Scott, B. C. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 19 Mar 1957. 10p. GJO.

Two deposits of uraniferous asphaltite, the Mann No. 1 and Pallaoro Leases, occur where Turkey Creek breaches the hogback formed by the upturned edge of the Dakota formation a mile and a half southeast of Morrison, Jefferson County, Colorado. Both deposits are in the Upper Dakota sandstone which dips 25 to 30° to the east in the mine area. A fault dipping normal to the bedding and striking parallel to it controls the ore at both mines. Two possible sources of the uranium are: that is was deposited from hydrothermal solutions which traveled up the fault; or that it was deposited from circulating ground waters that migrated up dip to where they were dammed by the fault. In either case, exploration of the intersection of the lower Dakota sandstone with the fault is suggested. (auth)

665 (DAO-3-TM-42) URANIUM DEPOSITS OF THE MARSHALL PASS AREA, GUNNISON AND SAGUACHE COUNTIES, COLORADO. Ranspot, H. W.; Spengler, R. G. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Apr 1957. 36p. GJO.

Uranium prospecting focused on the Marshall Pass district during the summer and fall of 1955. Several companies at this time took up mining claims in the area and started exploratory work. To date, several prospects and two ore bodies were developed. These ore bodies and these prospects were found in Precambrian schists and granites, Ordovician Harding sandstone, Ordovician Fremont limestone, and Mississippian Leadville limestone. The ore bodies are vein type uranium deposits, one of which is along a large thrust fault. (auth)

666 (DAO-3-TM-43) GEOLOGY OF URANIUM OCCURRENCE IN THE VAIL PASS AREA, EAGLE COUNTY, COLORADO. Campbell, G. C.; Schlottmann, J. D. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 11 Apr 1957. 19p. GJO.

Uranium occurrences in the Vail Pass area are restricted to micaceous sandstones and shales and carbonaceous, phosphatic limestones in the upperpart of the Minturn formation of Pennsylvanian age. The uranium minerals are epigenetic and are believed to have been concentrated by precipitation from circulating meteoric waters. The mineralized zones are 1.5 to 2.0 feet in thickness and cannot be economically mined under the present ore buying schedules. (auth)

667 (DAO-3-TM-45) URANIUM OCCURRENCES ON THE ALASKA HUMES CLAIMS IN THE RABBIT EARS PASS AREA, GRAND AND JACKSON COUNTIES, COLORADO. Schlottmann, J. D. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 8 Oct 1957. 15p. GJO.

A carnotite-type uranium deposit has been discovered about two miles southeast of Rabbit Ears Pass on the Alaska Humes claims. The deposit should achieve production but the ore will be of low grade, averaging about 0.22% U_3O_8. A series of anomalies trend north and south across these claims for a distance of 1½ miles, only a small portion of which has been extensively explored. The uranium is in the upper part of the Dakota sandstone. Locally, the upper Dakota is bentonitic and contains interfingering lenses of tuffaceous clay and mudstone in the vicinity of the deposit. A strike slip fault has been found 100 feet north of the ore body. No evidence has been found that will relate the ore body to the fault. (auth)

668 (DAO-3-TM-46) AIRBORNE AND GROUND RECONNAISSANCE OF THE TOMICHI DOME AREA, GUNNISON COUNTY, COLORADO. Spengler, R. G.; Ranspot, H. W.; Smith, B. C. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Nov 1957. 20p. GJO.

An airborne program was initiated in the Tomichi Dome area, Gunnison County, Colorado in July of 1956. The structural and lithologic similarities of this area to the Cochetopa uranium mining district warranted an evaluation of the uranium potential of the area. The radiometric data was analyzed statistically and interpreted geologically. Six areas were outlined showing readings greater than four standard deviations from the means. (auth)

669 (DAO-4-TM-2) PRELIMINARY RECONNAISSANCE OF URANIUM OCCURRENCES IN THE HUECO MOUNTAINS, EL PASO AND HUDSPETH COUNTIES, TEXAS. Collins, G. E. (USAEC Division of Raw Materials, Albuquerque, N. Mex. Albuquerque Branch Office). 10 Aug 1956. 12p. GJO.

The Hueco Mountains, located about 25 miles east of El Paso, Texas, are composed chiefly of folded marine limestones of Paleozoic age intruded by dikes, stocks, sills, and laccoliths of Tertiary porphyritic syenite. Scattered occurrences of tyuyamunite have been found with caliche on vertical joints in late Paleozoic limestone in the central Hueco Mountains. The present distribution of this tyuyamunite is believed to be the result of transportation by ground waters. Selected samples from these occurrences contained less than 0.02 percent U_3O_8, and no commercial tonnage of uranium ore has as yet been discovered. A minor occurrence of thorium-uranium-bearing quartzite at contact of the Bliss sandstone of Ordovician (?) age and the underlying Precambrian granite porphyry has been discovered at the south end of the Hueco Mountains. Assays have shown a

small content of uranium and thorium. It is doubtful that the property will be of commercial interest for either thorium or uranium. Although the Hueco Mountains have been the site of considerable igneous activity, the lack of favorable host rocks gives the area only a very modest potential for uranium. (auth)

670 (DAO-4-TM-8) EXPLORATION DRILLING IN THE LADRON PEAK AREA, SOCORRO COUNTY, NEW MEXICO. Collins, G. E.; Nye, T. S. (USAEC Division of Raw Materials, Albuquerque, N. Mex. Albuquerque Branch Office). Dec 1957. 25p. GJO.

Uranium deposits at the Jeter mine in the Ladron Peak area, Socorro County, New Mexico, are associated with a low angle contact fault zone between Precambrian granite and overlying Tertiary sedimentary and volcanic rocks. A drilling project was carried out to evaluate the favorability of the fault zone for additional uranium deposits. The results of the drilling indicate that the ore bodies are surrounded by halos of low uranium content and that additional deposits may be found in the area. (auth)

671 (DEB-3-TM-27) RECONNAISSANCE FOR URANIUM IN THE JULESBURG BASIN, LOGAN COUNTY, NORTHEASTERN COLORADO. Brown, L. J. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 8 Dec 1955. 10p. GJO.

Reconnaissance for uranium deposits in the Julesburg Basin has thus far failed to turn up any significant radioactive anomalies in that portion of the basin lying in northeastern Colorado. Three small anomalies, all in the Tertiary White River Formation, were investigated but showed very low uranium content. Airborne reconnaissance by the Atomic Energy Commission over certain regions within the basin is recommended. (auth)

672 (GJO-933-1) INVESTIGATIONS OF THE RELATIONSHIP BETWEEN ORGANIC MATTER AND URANIUM DEPOSITS. Part I. Literature Review and Delineation of a Comprehensive Research Program. Schmidt-Collerus, J. J. (Denver Research Inst., Colo (USA)). 31 Aug 1967. 146p. GJO.

A comprehensive literature survey was conducted to evaluate the present state of knowledge concerning the relationship between organic matter and uranium deposits. The discussion of this review forms the basis for the outline of a proposed experimental long-range research program for a detailed investigation of this association. The objective of the proposed program is to provide more quantitative criteria and establish tests for the definition and evaluation of large favorable areas of uranium deposits. (auth)

673 (RME-28) SUPPLEMENTARY REPORT ON AIRBORNE RADIOACTIVE ANOMALY NOS. 12, 13, 14, 24, 26, PUMPKIN BUTTES DISTRICT, WYOMING. Magleby, D. N.; Biggins, J. G. (USAEC Grand Junction Office, Colo.). 25 Sep 1952. 11p. GJO.

Anomaly Nos. 12, 13, 14, 24, and 26, all discovered by airborne radiometric survey, are similar in geologic and mineralogic characteristics and are in the same general area. They are, therefore, treated together in this report. The assay results and area of distinctive radioactivity, as determined by surface examination, limit the potential ore producers to anomaly Nos. 13, 14, and 26. The mineralized zones at anomaly Nos. 13 and 14 are very small, and care must be taken when mining to keep these small concentrations of ore free from the non-mineralized country rock. A mining concern would have to hold the mineral rights to all of these anomalies for any paying operation. The radioactivity on the ground as measured by a Detectron Geiger counter and a model 939 Halross scintillometer, is not always a true representation of either the equivalent or chemical uranium content as verified by chemical and radiometric analysis. This discrepancy might be attributed partly to the inability to obtain a true sample, from these types of deposits, in accordance with the radioactivity that is being measured. No further work by the Commission is recommended. Because of the small size of these deposits actual mining would be the most practical approach to development of the deposits. It is possible that trenching or bulldozing, other than stripping the overburden, would destroy the major part of the ore bodies without revealing any clue as to their extent. If mining is not feasible, wagon drilling would be the best alternative. (ERB)

674 (RME-30) SUPPLEMENTARY REPORT: PUMPKIN BUTTES DISTRICT, WYOMING, ANOMALY NOS. 1, 2, 5, 10, 11, 23. Magleby, D. N.; Biggins, J. G. (USAEC Grand Junction Office, Colo.). 1 Oct 1952. 9p. GJO.

The average size of these deposits is small, and actual mining would be the most practical method of determining the subsurface continuity of the deposits. It is thought that trenching or bulldozing, except for the stripping of overburden, might destroy the part of the ore bodies without revealing any clue as to their extent. If mining were not considered feasible, wagon drilling would be an alternative method of developing the ore deposits. No additional work by the Atomic Energy Commission is recommended. (auth)

675 (RME-39) SUPPLEMENTARY REPORT, MONUMENT HILL AREA, CONVERSE COUNTY, POWDER RIVER BASIN, WYOMING, ANOMALIES NUMBERED 77, 88, 89, 90. Magleby, D. N. (USAEC Grand Junction Office, Colo.). 10 Jun 1953. 8p. GJO.

Physiography, geology, and mineralization of anomalies 77, 88, 89, and 90 are discussed. It is concluded that actual mining of these small concentrations of radioactive material would be the best method for exploring and developing these deposits. (LK)

676 (RME-41) SUPPLEMENTARY REPORT ON AN ANOMALOUS AREA IN THE GREEN RIVER DESERT, EMERY COUNTY, UTAH. Klosterman, G. E. (USAEC Grand Junction Office, Colo.). 20 Jul 1952. 7p. GJO.

The assay reports were low, indicating very little mineralization at the surface. The rock at the surface had very little porosity and permeability. With depth along the fault, an increase of rock porosity or permeability may be a suitable environment for increased mineralization. The area has fair possibilities of being mineralized at depth along the fault. A few hundred feet of exploratory drilling could be expended and would give a fairly accurate measurement of the mineralization in the area. (auth)

677 (RME-45) AIRBORNE RECONNAISSANCE OF THE PUMPKIN BUTTES AND CONVERSE COUNTY AREAS, WYOMING. Mallory, N. S. (USAEC Grand Junction Office, Colo.). 7 Jul 1953. 13p. GJO.

An airborne radiometric survey was begun in the Pumpkin Buttes area on September 1, 1952, and terminated because of weather on November 27, 1952. Work was resumed in the Pumpkin Buttes area and Converse County on May 1, 1953, and stopped on July 7, 1953, when private exploration had become so active as to make further work by the Atomic Energy Commission unproductive. One hundred radioactive anomalies were located by airborne methods. This area has excellent possibilities of becoming an important uranium producer. (auth)

678 (RME-46) AIRBORNE RADIOMETRIC SURVEY OF LUSK AREA, NIOBRARA, PLATTE, AND GOSHEN COUNTIES, WYOMING. Mallory, N. S. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). 25 Aug 1953. 11p. GJO.

The three districts covered during the airborne radiometric survey, Hartville uplift, Old Woman anticline, and Lance Creek anticline, all proved to be negative as potential uranium producers. Only high background areas of radioactivity were discovered in the Hartville uplift. In the Old Woman anticline three high background areas, previously reported by the Atomic Energy Commission, were the only radioactive areas discovered. Three minor anomalies were encountered in the Lance Creek anticline. Of the thirteen anomalous areas discovered, only these three were of sufficient magnitude to be considered anomalies. These are in the White River formation (Oligocene). Upon subsequent ground investigation, these anomalies were found to contain only very low-grade uranium minerals. (auth)

679 (RME-50) DISCOVERY PLANNING FOR URANIUM IN MONUMENT VALLEY, ARIZONA AND UTAH. Mitcham, T. W. (USAEC Grand Junction Office, Colo.). 29 Sep 1953. 12p. GJO.

A new exploration program is being undertaken by the Atomic Energy Commission in the Monument Valley area of Arizona and Utah. The program is planned in three phases: (1) exhaustive search for ore guides in the Shinarump conglomerate, (2) application of recognized guides in ore search in the Shinarump, (3) application of the above two phases to other horizons of known mineralization. This paper is largely concerned with the planning of phase No. 1. Twenty-six possible ore guides are listed, which will be checked for validity. (auth)

680 (RME-52) SUMMARY OF AIRBORNE RADIOMETRIC SURVEYING IN THE BLANDING, UTAH AREA. Quaglin, L. R. (USAEC Grand Junction Office, Colo.). 30 Sep 1953. 12p. GJO.

Parts of the Morrison formation of the Jurassic period outcropping in the Blanding, Utah area were surveyed during August and September of 1953, for abnormally high radioactivity. A Piper 135, Super Cub, PA-18 aircraft, equipped with a Mark VI scintillometer, was used. A total time of 64 hours and 35 minutes, which includes rim, grid, reconnaissance, as well as cross-country flying, was necessary to cover the approximately 400 square miles representing the area. No new anomalies were located. Local highs in radioactivity were found to be claimed upon investigation by the ground personnel. Samples from some of these claims when assayed did not represent economic uranium deposits. The Vanadium Corporation of America and the Hole-in-Rock mines are both mining uranium ore in the area. (auth)

681 (RME-54) SUMMARY OF AIRBORNE RADIOMETRIC SURVEYING IN GRAND, SAN JUAN, EMERY AND WAYNE COUNTIES, UTAH, AND MONTROSE COUNTY, COLORADO. Nash, A. L. (USAEC Grand Junction Office, Colo.). 3 Oct 1953. 20p. GJO.

Airborne radiometric surveying in Grand, San Juan, Emery, and Wayne Counties, Utah, and Montrose County, Colorado, was conducted by the Atomic Energy Commission between November 24, 1952 and June 12, 1953. Five general geographic areas were surveyed: the Lisbon Valley area, the Indian Creek area, the Green River Desert-Cataract Canyon area, the Inter-River area, and the Skein Mesa area. Twenty-seven anomalous areas of radioactivity were found and probably the most significant result of the survey was the discovery of numerous anomalies in the Cutler formation in the Indian Creek area. (auth)

682 (RME-84) URANIUM DEPOSITS OF THE VEGITAS CLUSTER RIO ARRIBA AND SANDOVAL COUNTIES, NEW MEXICO. Brown, H. G. III. (USAEC Grand Junction Office, Colo.). Jun 1955. 13p. GJO.

Uranium mineralization found in the Vegitas Cluster was restricted to the upper arkosic limestone member of the Madera formation and to the lower portion of the Cutler formation (Abo formation). Generally, the mineralization is of the copper-uranium type and occurs as impregnations in light gray arkosic lenses and mudstone or siltstone beds underlain or overlain by arkosic lenses. The mineralization is commonly associated with carbon in the form of trash or logs, and green mudstone galls. There is no intimate relation between the copper and uranium mineralization, but it was noted that copper mineralization was found only when carbon was present. Scour fillings of light gray arkose or arkosic sandstone, with a grain size ranging from medium to very coarse, have been the best guides to ore. The various red colored sands appear to be unfavorable hosts. No systematic exploration and development program has been undertaken in the Vegitas Cluster, and development work has been limited to a few pits, minor rim stripping, and limited core and wagon drilling. Therefore, most of the deposits must still be classified as undeveloped prospects. (auth)

683 (RME-97(Pt. 2)) RECONNAISSANCE FOR URANIUM IN THE UPPERMOST CRETACEOUS AND EARLY TERTIARY ROCKS OF THE EASTERN SAN JUAN BASIN, NEW MEXICO. Chenoweth, W. L. (USAEC Grand Junction Office, Colo.). May 1957. 19p. GJO.

A reconnaissance of some 900 square miles of uppermost Cretaceous and early Tertiary rocks in the eastern San Juan Basin, New Mexico failed to locate any uranium deposits of economic significance. Sandstones of the Yegua Canyon facies of the Eocene San Jose Formation, a heavy sandstone facies of the Paleocene Nacimiento Formation, and the Cretaceous Ojo Alamo Sandstone all appear to be favorable host rocks for additional small deposits. (auth)

684 (RME-112) GEOLOGY OF URANIUM DEPOSITS IN THE INTER-RIVER AREA, GRAND AND SAN JUAN COUNTIES, UTAH. McRae, O. M.; Grubaugh, P. L. (USAEC Grand Junction Office, Colo.). Nov 1957. 44p. GJO.

The Inter-River area is a region of 450 square miles at the junction of the Green and Colorado Rivers in southeastern Utah. Commercial uranium deposits are found in two units of the Triassic Chinle formation: the Moss Back or basal member and the Black Ledge, a middle Chinle sandstone unit. The most important local controls in the deposition of uranium ore are paleostream channels, intraformational scours, carbonaceous material, and jointing within channels and scours. Most ore bodies contain less than 200 tons of ore. Non-commercial uranium deposits have been found in both the Permian Cutler and Triassic Moenkopi formations. During investigations of the area, the Atomic Energy Commission drilled selected areas in Mineral Bottom, Mineral Canyon, Taylor Canyon, and Fort Bottom. (auth)

685 (RME-120) EXPLORATION DRILLING IN THE HAYSTACK BUTTE AREA, MCKINLEY COUNTY, NEW MEXICO. Fincher, F. R.; Konigsmark, T. W. (USAEC Grand Junction Office, Colo.). Jan 1957. 35p. GJO.

The U. S. Atomic Energy Commission conducted a drilling program in McKinley County, New Mexico, from August 19, 1953 through April 19, 1954, to explore the Jurassic Todilto limestone for uranium occurrences on the eastern, northeastern, northern, and northwestern sides of Haystack Butte. A subsidiary purpose was to evaluate the technique of dry, non-core rotary drilling in exploration. Under contract AT(05-1)-240 there were 606 non-core holes drilled, totaling 72,018 feet. Under contract AT(05-1)-236 there were 36 core holes drilled, totaling 10,647 feet. The drilling areas covered parts of nine sections in T. 13N., Rs. 10 and 11 W. Uranium mineralization in the Haystack Butte area is closely associated with folds, faults, and joints, all of which are genetically related to the Zuni uplift. Uranium usually occurs in association with fluorite, barite, pyrite, and abundant hematite. Dry, non-core rotary drilling proved to be highly satisfactory, in spite of the contamination of samples caused by the caving of poorly consolidated and unconsolidated materials overlying the limestone. (auth)

686 (RME-133) GEOLOGIC STUDY OF THE BIDAHOCHI DIATREME. Miller, W. C. (USAEC Grand Junction Office, Colo.). Oct 1958. 17p. GJO.

Bidahochi diatreme is one of over 200 diatremes of the Hopi Buttes area in northeastern Arizona. It was formed by explosive volcanic force, and its present structure resulted from collapse into the vent produced by the explosion. The materials in the roughly circular diatreme consist of (a) lacustrine sediments of both pyroclastic and fluvial origin and (b) material deposited by ascending solutions. Both types were evidently being deposited during the period of collapse, since both have structures that must have been produced by collapse. Dips are lowest near the center of the diatreme and greatest around the periphery. The country rock (the lacustrine portion of the Pliocene Bidahochi formation) is practically unaltered adjacent to the diatreme, and fractures near the diatreme conform to the general pattern of the area. The diatreme is mostly rimmed by a conspicuous outcrop of travertine. The travertine is in most places in contact with the country rock, although in part it is separated from the country rock by a few feet of basaltic tuff; it was probably deposited by solutions that ascended essentially along the walls of the diatreme. Unidentified uraniferous minerals also occur in places at or near the periphery of the diatreme. They also were probably deposited by low-temperature solutions that ascended the diatreme walls. No ore-grade material was found. (auth)

687 (RME-1007) PRELIMINARY REPORT ON GEOLOGIC RECONNAISSANCE IN RALSTON CREEK-GOLDEN GATE CANYON AREAS, JEFFERSON COUNTY, COLORADO. Riley, T. H. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 23 Dec 1953. 12p. GJO.

The Ralston Creek-Golden Gate Canyon area occupies approximately twenty square miles of Jefferson County, Colorado. The area is drained by Ralston Creek and Golden Gate Canyon. Uranium is now being produced from the Ralston Creek Mine and a few tons of copper ore have been shipped from the North Star Mine. Major structural features have been mapped by aerial photo interpretation and field examination. Rocks in the area are composed of pre-Cambrian Idaho Springs formation, Pennsylvanian and younger sediments, and a Tertiary basalt dike. In general, the metamorphic structure trends from east-west to N. 60° W. Breccia reefs dominate the structural picture. The Hurricane Hill Breccia Reef and the Rogers Breccia Reef have been mapped for a distance of more than 15 miles to the northwest, trending S. 40° E. Four east-west cross faults and numerous north-south breccia zones have been mapped between the main breccias. Mineralization is of at least two types. Pre-Cambrian veinlets of scheelite in high calcium rocks follow the intricate foliation of the schist. Copper-uranium mineralization is associated with Tertiary breccia zones. Primary minerals associated with the pitchblende are chalcopyrite, galena, sphalerite, bornite, covellite, molybdenite, quartz, and carbonates. Secondary minerals identified megascopically are: torbernite, autunite, malachite, azurite, chrysocolla, native copper, and limonite. The Ralston Creek-Golden Gate Canyon areas are outside of any of the typical vein-type mining districts of the Front Range Mineral Belt. The frequent association of uranium with copper mineralization is a very useful guide in prospecting and exploring for uranium in this area. (auth)

688 (RME-1041) FINAL REPORT: AIRBORNE RADIATION DETECTION SURVEY, JEFFERSON COUNTY, COLORADO AND ADJACENT AREAS. Mallory, N. S.; Bird, A. G. (USAEC Grand Junction Office, Colo.). 29 Dec 1953. 10p. GJO.

Between November 1, 1953 and December 1, 1953, an airborne radiation detection survey was made of a portion of the Colorado Front Range within a radius of about 100 miles of Denver. A Piper P.A.-18 aircraft equipped with a Mark VI scintillation counter was used to fly the above mentioned area. The main objective of the survey was to locate new radioactive anomalies in the Ralston Creek area. Secondary objectives were to fly the area west of Ralston Creek to the Continental Divide, to fly the Dawson Arkose east of Denver, and to fly north of Boulder along the upturned Morrison and Dakota formations which flank the pre-Cambrian complex. One true anomaly was detected along the north flank of James Peak on the Continental Divide. Weather conditions made it impossible for ground crews to examine this anomaly. (auth)

689 (RME-1051) AIRBORNE AND GROUND RECONNAISSANCE OF THE LLANO AREA, TEXAS. Malan, R. C.; Nash, A. L. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 20 Sep 1954. 12p. GJO.

The Denver Exploration Branch of the Atomic Energy Commission completed an airborne and ground radiometric reconnaissance of the Llano area, Texas, during the spring of 1954. The reconnaissance work was concentrated on faults, Cambrian sandstones, a Pennsylvanian phosphorite bed, and known mines. Other Pennsylvanian strata and the pre-Cambrian complex, including pegmatites, were examined less intensively. No radiometric anomalies were found in the sediments or the mines. No anomaly in the granite, gneiss, or pegmatites was sufficiently strong nor extensive to be considered significant. There is not enough abnormal radioactivity known in this area to justify additional work by Commission employees at this time. (auth)

690 (RME-1061) AIRBORNE RECONNAISSANCE OF EASTERN FLANK OF THE BLACK HILLS, SOUTH DAKOTA. Nash, A. L. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). 10 May 1955. 16p. GJO.

An airborne radiometric survey of the Inyan Kara group of formations exposed along the eastern flank of the Black Hills Uplift was started by the Atomic Energy Commission July 29, 1953 and completed October 31, 1953. Nine areas of anomalous radioactivity were discovered, all in the Fall River sandstone. (auth)

691 (RME-1064) RESULTS OF AIRBORNE RECONNAISSANCE AND EXPLORATION IN THE TROUBLESOME AREA, MIDDLE PARK, GRAND COUNTY, COLORADO. Schlottmann, J.; Brown, L. J. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). 22 Jul 1955. 22p. GJO.

Uranium has been found in the Troublesome formation and a regolith zone in Middle Park, Colorado. The Park is a basin between the Front and Park Ranges where pre-Cambrian, Permo-Pennsylvanian, Jurassic, Cretaceous, and Tertiary rocks have been uplifted, folded, and faulted. All of the known uranium mineralization in the Troublesome Creek area is in the lower 160 feet of the Troublesome formation and is in an area of approximately 40 square miles. These deposits occupy sandstone lenses varying up to 20 feet in length, 5 to 10 feet in width and 1 to 4 feet in thickness. Extensive exploration by auger and rotary drilling, shafts, test pits, and trenching indicate these deposits are too small or low grade to warrant mining operations. Secondary uranium minerals of commercial tonnage and grade occur in the regolith zone between the Pierre shale and a pre-Cambrian complex in the withdrawn area near Beaver Creek. These deposits are not being worked pending attempts to revoke the withdrawal. Airborne radiometric reconnaissance of the Dakota and Morrison sediments on the flanks of the basin and a portion of the Tertiary sediments within the basin failed to extend the area of known mineralization. (auth)

692 (RME-1084) URANIUM DEPOSITS IN THE CEMENT AREA, CADDO COUNTY, OKLAHOMA. Beroni, E. P.; Latta, T. E. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). Sep 1958. 56p. GJO.

During the summer of 1958, 28.94 tons of uranium ore averaging 1.28% U_3O_8 and 0.55% V_2O_5 were shipped from Cement, Caddo County, Oklahoma, to the A. E. C. buying station at Grants, New Mexico. This was the first uranium production from the State of Oklahoma. The deposit is one of many occurrences of secondary uranium minerals, principally carnotite and tyuyamunite, that are distributed in the Permian "red beds" along the northern flank of the Anadarko basin. Uranium in the Cement area occurs near the axis of a faulted anticlinal structure, within the Anadarko basin. From preliminary airborne and carborne investigations, supplemented with limited drilling, and evaluation of gamma-ray logs, it appears that the most favorable areas for exploration in the Cement area are in parts of secs. 2 and 3, T. 5N., R. 9 W. This area is approximately 1¼ miles in length and ¼ to ¾ of a mile in width, along the crest of the Cement dome. In general, areas underlain by highly carbonate-cemented sandstone and gossan-like, intensely iron-stained zones are favorable for uranium occurrences. Lack of proper exploration and of drill cores or cuttings precludes any reasonable estimate of indicated or inferred uranium reserves for the area at this time. However, drilling to date indicates zones of high radioactivity, tabular in shape, and associated with hard carbonate-cemented horizontal sandstone beds at depths of approximately 100 feet. No drilling has penetrated the water table, which is at a depth of approximately 100 feet, where possibilities exist for additional uranium deposits. (auth)

693 (RME-2070) GEOLOGY AND URANIUM OCCURRENCES NEAR LAKEVIEW, OREGON. Cohenour, R. E. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). Jul 1960. 37p. GJO.

The possibility of finding additional epithermal uranium deposits in the volcanic rocks of the Lakeview area is fair to good. Additional detailed geologic mapping will be necessary to evaluate the area adequately. Investigations show that the uranium mineralization was closely related to intrusive rhyolites. The intrusive rhyolites within the Lakeview area trend in a belt 1 mile in width diagonally through the area for at least 15 miles from southeast to northwest. Basaltic rocks, both intrusive and extrusive, are not known to contain any significant amounts of uranium minerals within the area. However, faulting of basalts to the zone of vadose (practically no circulation) waters may afford an environment whereby uranium deposits may form. Physical and chemical characteristics of the rocks and fault zones that form the conduits through which the metal-bearing magmatic waters passed were most important in the localization of the ore bodies. Originally, the rocks must have been sufficiently competent to fracture, and to have been of such mineral composition to allow formation of an abundance of clay clogging material to restrict and force percolating ore solutions into various routes. This situation coupled with relatively rapid temperature and pressure (hydrostatic) changes promoted the dispersal of uranium minerals into many, small usually widely separated bodies. Cooling and shrinkage of rocks within an area that has undergone extensive volcanism will further cause disruption of strata and enclosed ore bodies. The foregoing conditions emphasize the futility of correlation and outlining or extending ore bodies by a drilling program. Drillhole spacing would by necessity have to be so closely spaced as to become an economic impossibility relative to the size of ore bodies which may be expected. Ore bodies may be of a fair size up to several thousand tons but continuity of the ore should not be expected. Uranium ores within the Lakeview district are amenable only to small mining operations. The genesis of the uranium in the district closely resembles that of most mercury deposits. As in mercury deposits, large, well managed, open pit or underground operations will generally not be successful based on mining ore stringers. In prospecting for uranium in a volcanic area with an average rainfall similar to the Lakeview area, anomalies may be expected in siliceous and silicified rocks, but the best ore bodies are most likely to be found in soft tuffaceous rocks. Siliceous rocks tend to stand in relief and are more readily accessible to surficial radiometric detection, whereas tuffaceous rocks erode readily and the contained ores are deeply covered by alluvium and soil. (auth)

694 (RMO-415) GAMMA RAY LOGGING OF DRILL HOLES IN THE CALAMITY DISTRICT, UNCOMPAHGRE UPLIFT AREA, COLORADO. Guillotte, G. B. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 26 Feb 1947. 79p. GJO.

Declassified 30 Dec 1957.

Data are tabulated for hole number, depth, log position, thickness, actual percent for stated thickness (%SOI), product of thickness times grade of ore (T × G), half breadth of deflection curve measured in feet (B), and product of net maximum deflection times half breadth (D × B). D × B is the direct measurement of radioactivity which is converted to T × G by ratios established from calibration. (HLW)

695 (RMO-416) GAMMA RAY LOGGING OF DRILL HOLES IN THE SLICK ROCK DISTRICT, DOLORES PLATEAU AREA, COLORADO. Guillotte, G. B. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Feb 1947. 32p. GJO.

Results from the gamma logging of drill holes in the Slick Rock District are tabulated. (LK)

696 (RMO-441) FIGURES, PROFILES, AND COLUMNAR SECTIONS ON WESTERN CARRIZO UPLIFT AND CHUSKA MTS. AREAS, NORTHERN NAVAJO INDIAN RESERVATION, NORTHEASTERN ARIZONA. Harshbarger, J. W. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Apr 1946. 82p. GJO.

697 (RMO-442) REPORT ON RIFLE MINE LOCALITY, GRAND HOGBACK DISTRICT, WHITE RIVER UPLIFT AREA, COLORADO. Smith, C. T. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Apr 1946. 33p. GJO.

Uranium mineral resources of the Rifle Mine near Rifle, Colorado were studied. Geology of the uranium–vanadium deposits of the area is emphasized. Topics discussed are geography, geologic relations, ore deposits, conditions affecting mining, ore reserves, and exploration. Tables, figures, calculation tables, columnar section, and a list of large maps that accompany the report are included. (JGB)

698 (RMO-444) REPORT ON EURIDA (TOH ATIN) DISTRICT, CARRIZO UPLIFT AREA, ARIZONA. Eakland,

E. H. Jr. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Apr 1946. 39p. GJO.

The Salt Wash sandstone of the district was investigated in order to determine the amount of uranium–vanadium mineralization. The Jurassic formations exposed in the district were studied as to their lithology, stratigraphy, sedimentation, and structure. Section headings include: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Also included are figures, columnar sections, and a list of maps accompanying the report. (JGB)

699 (RMO-445) REPORT ON THE ABAJO MOUNTAINS DISTRICT, GREEN RIVER DESERT AREA, UTAH. Smyth, S. K. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Feb 1946. 32p. GJO.

The Abajo Mountains District was investigated in order to delineate the Morrison and adjacent formations and to prospect for and examine any outcrops of uranium–vanadium minerals, from which information on ore reserves might be determined. A geological investigation was completed. Section headings of the report include: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Tables, figures, and a list of large maps accompanying the report are included. (JGB)

700 (RMO-446) REPORT ON COYOTE MESA DISTRICT, DOLORES PLATEAU AREA, COLORADO. Wardwell, H. R. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Apr 1948. 76p. GJO.

Geography, geology, stratigraphy, mineralization, and ore deposits of the area are discussed. A list of mineral claims is given. Conditions affecting mining, ore reserves, and exploration are discussed. (JGB)

701 (RMO-449) BLANDING DISTRICT SAN JUAN BASIN AREA, UTAH. Smyth, S. K. (USAEC Grand Junction Office, Colo.). Feb 1946. vp. GJO.

Declassified 33 Mar 1960.

Uranium–vanadium resources of the district were evaluated. An effort was made to observe features that might serve as guides for predicting new ore bodies, extensions of known ore bodies, or terrain favorable for prospecting. The following topics are discussed: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Summary tabulations and a list of large maps that accompany the report are included. (JGB)

702 (RMO-450) REPORT ON BEAVER CREEK MESA DISTRICT, GREEN RIVER DESERT AREA, COLORADO-UTAH. Metzger, O. H. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Jan 1946. 35p. GJO.

A survey was conducted to study the Salt Wash member of the Morrison formation and examine it for mineralization, to map all mineral occurrences, to make tonnage estimates, and to determine possibilities for future development. Descriptions are given of the geography, geologic relations, stratigraphy, ore deposits, mineralization, conditions affecting mining, and ore reserves. Maps and tables of data are included. (HLW)

703 (RMO-451) REPORT ON CARPENTER RIDGE DISTRICT, DOLORES PLATEAU AREA, COLORADO. Miller, G. B. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Jan 1946. 55p. GJO.

A survey was conducted to determine and record vanadium resources of the district and to observe any geological features which might serve as guides for predicting the existence of unexposed mineralization. Descriptions are given of the geography, geologic relations, stratigraphy, ore deposits, mineralization, conditions affecting mining, and ore reserves. Maps and tables of data are included. (HLW)

704 (RMO-453) REPORT ON LIGHTNER CREEK DISTRICT, SAN JUAN BASIN AREA, COLORADO. Keith, S. B. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Dec 1945. 21p. GJO.

The form of occurrence, tonnage, and grade of uranium ores in the Lightner Creek District were studied. The following topics are discussed: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Summary tabulation tables, figures and columnar sections, and note of a large map accompanying the report are included. (JGB)

705 (RMO-454) SUPPLEMENTARY REPORT ON INTER RIVER DISTRICT, GREEN RIVER DESERT AREA, UTAH. Smith, C. T.; Hill, J. W. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Nov 1945. 26p. GJO.

A supplement to a previously submitted report on the Inter River District is presented. Detailed calculations of uranium ore reserves, some additional information on the geology of the mineralized areas, and more complete recommendations for exploration of the district are included. Topics discussed in regard to the East Lobe are: geologic relations, production, ore reserves, and exploration. The Center and West Lobes are discussed briefly. Tables and a list of large maps are also included. (JGB)

706 (RMO-455) REPORT ON THE BULL CANYON DISTRICT, DELORES PLATEAU AREA, COLORADO. Emerson, J. F. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Nov 1945. 35p. GJO.

The district was found to have considerable potential as a producer of uranium and vanadium ores. The general geology of the district was surveyed with special emphasis on the Morrison formation. All known mineralized occurrences were mapped and studied; lithology and stratigraphic position of all deposits were recorded, and ore reserves were estimated. Topics discussed are: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Tables and a list of large maps that accompany the report are included. (JGB)

707 (RMO-456) REPORT ON WEST PARADOX DISTRICT, DOLORES PLATEAU AREA, COLORADO-UTAH. Livingston, C. W. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Oct 1945. 47p. GJO.

The location, stratigraphic position, and extent of the known uranium–vanadium deposits were recorded. Topics discussed are: geography; geologic relations; ore deposits; conditions affecting mining; ore reserves; and exploration. Summary tabulations and a list of large maps accompanying the report are included. (JGB)

708 (RMO-459) DOLORES RIVER DISTRICT, DOLORES PLATEAU AREA, COLORADO. Van Voorhis, B. W. Jr. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Aug 1945. 44p. GJO.

Declassified 23 Mar 1960.

The purpose of the survey was to: (1) map and study the geologic formations exposed in the district with special emphasis on the study of the Salt Wash member of the Morrison formation; (2) record, carefully map, and study all occurrences of SOQ-vanadium ore found in the district; and (3) estimate tonnage and grade of any ore reserves that may occur in the area mapped. Almost 500,000 tons, with average grades of 0.10% U_3O_8 and 2.21% V_2O_5, of reserves in all categories have been calculated. (LK)

709 (RMO-467) REPORT ON THE POLAR MESA DISTRICT, GREEN RIVER DESERT AREA, UTAH. Emerson, J. F. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 16 May 1944. Contract W-7405-eng-78. 34p. GJO.

Declassified 1 Nov 1957.

Detailed sketches of 23 occurrences of mineralization are given. A few hundred tons of carnotite-bearing material averaging about 0.17% U_3O_8 can be obtained from this district. It was concluded that mineralization possibilities are not sufficiently encouraging to warrant drilling or other work. (LK)

710 (RMO-472) REPORT ON THE McELMO DISTRICT, SAN JUAN BASIN AREA, COLORADO. Metzger, O. H. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 17 May 1944. Contract W-7405-eng-78. 12p. GJO.

While extensive carnotite mineralization occurs in the Morrison formation to the south on the Navajo Indian Reservation in Arizona, this study demonstrated that there is no carnotite ore in the Morrison formation of the McElmo District. The only mineralization observed in the district consists of thin films of a vanadium mineral, occurring near faulting in rocks some distance stratigraphically below the Salt Wash sandstone — the favorable member of the Morrison formation for ore in other districts of the Colorado Plateau. (LK)

711 (RMO-477) FIELD SURVEY OF GREEN RIVER DISTRICT, SAN RAFAEL SWELL AREA, UTAH. VanVoorhis, B. W. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). 10 Jan 1944. Contract W-7405-eng-78. 51p. GJO.

Widespread but small occurrences of mineralization were found along two principal zones in the area. A tentative drilling program is given. (LK)

712 (RMO-479) REPORT ON TRACHYTE DISTRICT, HENRY MOUNTAINS AREA, GARFIELD AND WAYNE COUNTIES, UTAH. Mastrovich, A. M. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). 31 Dec 1943. 27p. GJO.

A detailed description of ore occurrences in Farmers Knob area of Henry Mountains and a tentative drilling program are given. (LK)

713 (RMO-480) NAVAJO INDIAN RESERVATION PRELIMINARY EXPLORATION ESTIMATE. Webber, B. N. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). 30 Dec 1943. 51p. GJO.

A preliminary report of occurrences of uranium–vanadium minerals in the Navajo Reservation, Arizona (Carrizo Uplift and Chuska Mountains area) is presented. Ore body estimates of the following areas are included: Kinusta, Toh Acon, and Eurida Districts. (JGB)

714 (RMO-669) TABLES OF URANIUM AND VANADIUM MINERALS WHICH ARE LARGELY OF SECONDARY ORIGIN. Gruner, J. W.; Gardiner, L. (Minnesota Univ., Minneapolis (USA)). [nd]. 82p. GJO.

These tables were prepared to help in the identification of the numerous secondary uranium minerals, usually hydrated, which occur with uraninite and other less well-defined primary minerals in zones of oxidation. They also occur in the Colorado Plateau region and similar areas of the world where primary oxides may be absent. The very nature of these minerals precludes a complete and errorless table, as some of the species are still in a dubious state of classification, and may be discredited later. The chief sources of information used in the compilation of the tables are listed. (auth)

715 (TM-1-D-15) AIRBORNE RADIOMETRIC SURVEY OF PARTS OF ALBANY AND CARBON COUNTIES, WYOMING. Shannon, S. S. Jr.; Ruzycki, J. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Oct 1957. 20p. GJO.

During the summer of 1956, an airborne radiometric survey was made by the U. S. Atomic Energy Commission in Albany and Carbon Counties in southcentral Wyoming. Formations ranging in age from Mississippian to Eocene were found in the Seminoe and Shirley Mountains, Freezeout Hills, and Laramie and Hanna Basins. Four areas of abnormally high radioactivity were discovered in the Cloverly formation of Cretaceous age; one other was discovered in the Morrison formation of Jurassic age. Two of the areas underlain by the Cloverly formation are on the northeastern flank of the Freezeout Hills; the other three areas are in the southern part of the Laramie Basin. Selected samples, none of which contained visible uranium minerals, assayed less than 0.02 percent eU_3O_8. The upper sandstone member of the Cloverly formation in the southern Laramie Basin, and the upper part of the Madison limestone in the Shirley and Seminoe Mountains and the Freezeout Hills, are considered the most favorable rocks for uranium exploration. (auth)

716 (TM-65) RECONNAISSANCE OF THE DE BEQUE AREA, MESA AND GARFIELD COUNTIES, COLORADO. McDougald, W. D. (USAEC Grand Junction Office, Colo.). 5 Aug 1954. 9p. GJO.

About 20 square miles of Paleocene Ohio conglomerate and lower-Eocene Wasatch strata were surveyed with a Halross scintillometer during the months of December 1953, and January 1954, in the Coon Hollow-Sulphur Gulch area southwest of DeBeque, Colorado. A smaller area of approximately 2 square miles of lower Green River and uppermost Wasatch strata, near the Carr Creek-Roan Creek junction, 18 miles northwest of DeBeque, Colorado, was also surveyed with the scintillometer. The ground survey was part of a check on reported anomalies in seismic shot holes logged by the AEC. No radioactivity of note was found. (auth)

717 (TM-79) DRILLING ON TENDERFOOT MESA, MESA COUNTY, COLORADO. Davis, W. T. (USAEC Grand Junction Office, Colo.). 17 Jan 1956. 17p. GJO.

The drilling of uranium–vanadium deposits at Tenderfoot Mesa began on July 7, 1951 and was completed on Jan. 25, 1952, with 20,907 feet of core drilling in 261 holes in one project and 22,469.8 feet of wagon drilling in 338 holes in the other project. A cost analysis of the study is included. (JGB)

718 (TM-81) DRILLING ON THE RUTH AND BRIGHAM CLAIMS, HOLBROOK AREA, NAVAJO COUNTY, ARIZONA. Gregg, C. C.; Moore, E. L. (USAEC Grand Junction Office, Colo.). 21 Mar 1956. Contract AT(30-1)-1361. 11p.

Drilling on the Ruth and Brigham claims in the Holbrook area disclosed small uranium orebodies and mineralization in the middle Chinle formation of Triassic age. The ore is concentrated in accumulations of carbon in paleostream channels and is often found above a white bentonitic mudstone. No further exploration is recommended for this area. (auth)

719 (TM-82) PRELIMINARY REPORT ON THE URANIUM POSSIBILITIES OF THE JEMEZ INDIAN RESERVATION AND JEMEZ PUEBLO GRANT, SANDOVAL COUNTY, NEW MEXICO. Brassfield, J. C. (USAEC Grand Junction Office, Colo.). 9 May 1956. 12p. GJO.

Eleven radiation anomalies were detected during an airborne survey and subsequent ground reconnaissance by the Atomic Energy Commission on the Jemez Indian Reservation and Jemez Pueblo Grant. One, in granite, is believed to be of no commercial importance, and two are at hot springs. No mineral deposits were found at another, but it is near a fault which bounds a thin sandstone bed in which six uranium occurrences of possible commercial value have been found scattered along rim outcrops of the Abo formation over a distance of half a mile. Mineralization at these six localities has been limited to a bed of coarse sandstone about 3 inches thick, 35 feet above the Madera limestone. Organic material has been replaced by chalcocite in this 3-inch bed, and uranium is present as carnotite and an unidentified mineral, dark gray or black, possibly pitchblende. Covellite has also been identified in hand specimens. The carnotite is associated with the copper minerals, as well as disseminated a few inches into the overlying sandstone. At one place the carnotite was found as a paint directly on the red sandstone. Test drilling will be necessary to determine whether or not any of the uranium deposits are sufficiently extensive and rich to be of commercial value. Radiometric analyses check closely with chemical analyses, indicating that the radioactivity of the uranium occurrences approximates equilibrium conditions, and hence that radiometric assays can be considered reliable. (auth)

720 (TM-92) APPLICATION OF THE DITHIZONE HEAVY-METALS TEST TO URANIUM DEPOSITS OF THE CHINLE FORMATION NEAR CAMERON, ARIZONA. Wright, R. F. (USAEC Grand Junction Office, Colo.). 4 Jan 1957. 17p. GJO.

Dithizone tests indicate that uranium-bearing altered sandy mudstone lenses in the Petrified Forest member of the Chinle formation near Cameron commonly have a high content of zinc, copper, and lead. The greatest concentration of heavy metals is usually in the lower 25 feet of the deposits, and in some localities may reach several thousand ppM in the lower parts, increasing toward the most depressed area of the saucer shaped deposits. The heavy metal content in unmineralized or unaltered Chinle is usually less than 150 ppM. (auth)

721 (TM-94) GEOLOGIC LOGS OF DRY HOLE OIL WELLS IN EMERY, GARFIELD, GRAND AND KANE COUNTIES, UTAH. Kastelic, W. R. (USAEC Grand Junction Office, Colo.). 16 Aug 1956. 10p. GJO.

Copies of logs of wells drilled for oil in east-central Utah accompany this memorandum. These logs record the subsurface stratigraphy and correlate the geologic formations. Accompanying each stratigraphic section is a gamma ray log, either Lane Wells or Schlumberger, which shows the amount of radioactivity within each formation. No attempt has been made to transpose the gamma ray log readings to uranium assays. The information used in this report was obtained from the files of the Oil and Gas Leasing Division of the U. S. Geological Survey in Salt Lake City, Utah. The geologic interpretation of each well is that of the oil company that drilled the well. In compiling several of the attached logs, additional lithologic information was obtained from lithologic logs compiled by the American Stratigraphic Company, 1820 Broadway, Denver, Colorado and made available to the government through the courtesy of the California Company, Grand Junction, Colorado. (auth)

722 (TM-97(Rev.)) PRELIMINARY INVESTIGATION OF TRIASSIC ROCKS IN THE LUKACHUKAI MOUNTAINS, ARIZONA. Kosatka, R. F. (USAEC Grand Junction Office, Colo.). 3 Dec 1956. 10p. GJO.

During the summer of 1955, two test holes were drilled into the Triassic Chinle Formation in the Lukachukai Mountains near Cove, Arizona, to obtain geologic information. Brief airborne and ground reconnaissance was made of Triassic outcrops near Cove. No anomalous radioactivity was found in the test holes, but chemical tests showed concentrations of heavy metals in conglomerate lenses in the Chinle Formation. Channel sandstones in the middle part of the Petrified Forest Member appear to be the most favorable for mineralization. The Shinarump Member, here underlain by a permeable unit, and occurring at depths greater than 500 feet, appears less promising for uranium exploration. (auth)

723 (TM-98) PRELIMINARY RECONNAISSANCE OF THE CENTRAL ZUNI UPLIFT, NEW MEXICO. Baumgardner, L. (USAEC Grand Junction Office, Colo.). 26 Nov 1956. 21p. GJO.

Two new localities of anomalous radioactivity were found in the central part of the Zuni uplift. Anomalous radioactivity was found in the San Andrea limestone within the Bluewater fault zone, but no direct connection between the fault and the source of radioactive material was proven. No evidence of uranium was found in connection with other faults within the central Zuni area, and no confirmation was found for the hypothesis that uranium may have risen from deep sources within the central Zuni area

and migrated thence along fault zones northeastward to the known deposits in the Todilto limestone and Morrison formation beyond the broad Grants valley. At the Copper Hill locality, uranium is associated with copper and carbonaceous material in a basal arkosic conglomerate of the Permian Abo formation resting on granite. No anomalous radioactivity was detected at the Section 21 fluorspar mine, nor in connection with the faults and basaltic lavas and tuffs of the belt of extrusives extending across the southeast end of the Zuni uplift. (auth)

724 (TM-99) RECONNAISSANCE FOR URANIUM IN THE TOADLENA AREA, SAN JUAN COUNTY, NEW MEXICO. Archer, B. J. Jr. (USAEC Grand Junction Office, Colo.). 8 Jan 1957. 40p. GJO.

A uranium reconnaissance in the Toadlena area, New Mexico, included airborne scintillation survey, ground checking of radioactive anomalies discovered from the airborne survey, ground mapping and radiometric checking of 34 miles of sedimentary rock outcrops, and examination of all areas of apparent intensive alteration or structural displacement. Only one area of anomalous radioactivity was considered worthy of detailed work. It is a weakly mineralized black sand deposit 2 to 8 feet wide, extending 1750 feet along the steeply dipping Gallup sandstone member of the Mesaverde group. This deposit has a mineral suite similar to titaniferous magnetite deposits of the major structural basins of Wyoming, but is not of apparent importance as a source of uranium. (auth)

725 (TM-100) RECONNAISSANCE OF THE RED CANYON AREA, SAN JUAN COUNTY, UTAH. Mace, E. V.; Oertell, E. W. (USAEC Grand Junction Office, Colo.). 30 Jan 1957. 8p. GJO.

A reconnaissance was made of the Red Canyon area, San Juan County, Utah, during the period November 22, 1952, to March 4, 1953. The principal objectives were to locate areas favorable to the occurrence of uranium ore, to study the geologic environment of the ore deposits, and to collect data for regional geologic studies of the Shinarump member of the Triassic Chinle formation. The studies revealed no new criteria for discovery of uranium deposits but a greater knowledge was gained of the regional distribution, lithology, and sedimentary trends of Shinarump strata and a study was begun of the regional paleostream drainage pattern in the Red Canyon area. As a result of the reconnaissance of the Red Canyon area, the Posey, Blue Lizard, and Markey localities were recommended for physical exploration by diamond drilling. Recommendations are made for rim stripping and plane table mapping of the Scotty-Copper King channel, and detailed study of the Plat May, Cub, Midas, Hersey, Danny Boy, Colorado, and Red Mac paleostream channels. (auth)

726 (TM-101) GEOLOGY AND URANIUM DEPOSITS OF CALF MESA, EMERY COUNTY, UTAH. Akright, R. L. (USAEC Grand Junction Office, Colo.). 4 Feb 1957. 13p. GJO.

Geologic work conducted by the U. S. Atomic Energy Commission in the Calf Mesa area, in the northern part of San Rafael Swell, Emery County, Utah, culminated in 1953 with an investigative and exploration drilling program that terminated in January, 1954. This was followed by a small development drilling project, which ended in May, 1955. This report is divided into three parts, each of which relates to one of the phases of work in the area; geology of the Calf Mesa area, investigative and exploration drilling, and development drilling. Uranium ore on Calf Mesa is in the Moss Back member of the Chinle formation, which forms a gently northerly dipping cuesta in the northwest part of the San Rafael Swell, a breached asymmetrical elliptical dome. Uranium production has been limited to infrequent shipments from three small mines. Three units of the Moss Back member of the Chinle formation are distinguishable: a lower sandstone unit; a middle mudstone, mudstone gall, and lime pebble conglomerate unit; and an upper sandstone unit. A fourth unit beneath these three composed of mudstone and lime pebble conglomerates may be correlative with the Monitor Butte member of the Chinle. Sporadic and inconsistent mineralization is associated with carbonaceous debris and asphalt. Localization of ore in the low of a scour in one area is the only certain ore control in the lower sandstone unit. The absence of red mudstone seems to be a local guide to mineralization. The mineralization appears to have occurred before faulting of the area. During the exploration drilling program two ore holes were located on withdrawn public domain in the northeastern part of Calf Mesa. Development drilling operations were performed in this area from April 27, 1955, through May 12, 1955, to determine whether or not the area contained a mineable ore body which could be leased to private industry for exploration. Twenty air rotary holes were drilled for a total footage of 2,660 feet, but no significant amount of ore was located. (auth)

727 (TM-102) INVESTIGATIVE DRILLING IN THE Bee AREA, WHITE CANYON, SAN JUAN COUNTY, UTAH. Grundy, W. D. (USAEC Grand Junction Office, Colo.). 28 Feb 1957. Contract AT(05-1)-221. 11p. GJO.

Thirty-seven holes totalling 4,723 feet were drilled in the Triassic Shinarump member of the Chinle formation in the Bee area, White Canyon mining district, San Juan County, Utah, to evaluate the uranium potential of the area. Only one hole encountered ore-grade uranium. A broad and shallow paleostream channel fill was traced for a distance of 2,100 feet. Argillaceous material is sparse in the basal channel fill, making it unfavorable for the deposition of uranium. Other criteria of favorability such as poor sorting, carbon trash, and pyrite are present. Argillaceous material is more common in channels which have deep and narrow cross sections. This offers a partial explanation of why no ore body was discovered in the Bee channel although some neighboring deep channels contain ore. (auth)

728 (TM-103) RECONNAISSANCE FOR URANIUM IN THE SOUTHERN CARRIZO MOUNTAINS, APACHE COUNTY, ARIZONA. Labrecque, R. A. (USAEC Grand Junction Office, Colo.). 20 Feb 1957. 9p. GJO.

A reconnaissance was conducted during parts of August and September, 1956, of an area about two miles square in the southern Carrizo Mountains where the Permian Cutler formation, including its DeChelly member, and the Triassic Shinarump member of the Chinle formation, are exposed. The purpose was to appraise the uranium potential of the area and to determine the cause of bleaching in the DeChelly. Extensive uranium mineralization in the Salt Wash member of the Morrison formation around the Carrizo Mountains suggested that the Shinarump, a good producer in other areas on the Colorado Plateau, might be mineralized here as well. Bleaching, as shown in the DeChelly, has proven such a useful guide to uranium at other localities as to merit investigation here. That the Cutler red beds are a poor host rock for uranium is indicated by the lack of carbon and bleaching. The DeChelly sandstone is also unfavorable because of its high permeability and absence of accepted uranium precipitants. On the basis of the outcrop area, the combination of the small extent and depth of the channels, silicification, absence of underlying impermeable strata, and absence of carbonaceous material, would seem to preclude the probability of commercial uranium deposits in the Shinarump of the Carrizo Mountains. (ERB)

729 (TM-104) INVESTIGATIVE DRILLING OF THE POSEY, BLUE LIZARD, AND MARKEY LOCALITIES, RED CANYON AREA, SAN JUAN COUNTY, UTAH. Mace, E. V.; Oertell, E. W. (USAEC Grand Junction Office, Colo.). 4 Mar 1957. 17p. GJO.

Red Canyon, approximately 70 miles west of Blanding, San Juan County, Utah, is on the west flank of the Monument Uplift, where exposed sedimentary rocks range from Permian to Jurassic in age. An investigative drilling program conducted from March 4, 1953 to May 7, 1953 consisted of 60 diamond drill holes totaling 5,533 feet. One diamond drill hole penetrated uranium of ore grade; twelve other holes encountered deposits of sub-ore grade. The Red Canyon uranium deposits are localized in channels cut into the Moenkopi surface, and filled with carbonaceous Shinarump sandstones. Information obtained from the exploration program indicates that the southeastern part of Red Canyon has a more suitable geologic environment for the occurrence of uranium than other portions. (auth)

730 (TM-116) EXPLORATORY DRILLING IN THE POSEY AND MARKEY LOCALITIES, RED CANYON AREA, SAN JUAN COUNTY, UTAH. Easton, W. W.; Oertell, E. W. (USAEC Grand Junction Office, Colo.). 18 Mar 1957. Contract AT(05-1)-236. 5p. GJO.

The Posey and Markey localities are in Red Canyon approximately 70 miles west of Blanding, Utah. The area is on the west flank of the Monument upwarp and exposed sedimentary rocks range in age from Permian through Jurassic (?). A program of exploratory drilling carried out in 1954 consisted of 33 diamond drill holes totaling 5,492.5 feet. Two holes penetrated ore and four encountered sub-ore grade material. Uranium mineral concentrations occur in fluviatile sedimentary rocks of the Shinarump and Monitor Butte members of the Triassic Chinle formation. The results of exploration in the favorable parts of the Posey and Markey localities indicate that they are less important than other uranium producing localities in the Red Canyon area. (auth)

731 (TM-125) EXPLORATORY DRILLING ON FREY POINT MESA, WHITE CANYON AREA, SAN JUAN COUNTY, UTAH. Miller, L. J.; Spencer, D. F.; Certell, E. W. (USAEC Grand Junction Office, Colo.). 26 Jun 1957. Contract AT(30-1)-1361. 16p. GJO.

Frey Point Mesa is in White Canyon, approximately 55 miles west of Blanding, San Juan County, Utah. The area is on the west flank of the Monument upwarp where exposed sedimentary rocks range from Permian to Jurassic in age. Exploratory drilling programs conducted from Oct. 25, 1952 to March 30, 1953 and from Nov. 14, 1953 to Jan. 19, 1954 consisted of 128 diamond drill holes totaling 16,191.1 feet. Twelve diamond drill holes penetrated uranium deposits of ore grade; twenty-two other drill hoes encountered deposits of sub-ore grade. Uranium deposits in the White Canyon No. 1 and Saddle channel localities on Frey Point Mesa are localized in Shinarump clastics containing an abundance of clayey and carbonaceous material deposited in paleostream channels cut into the underlying Moenkopi formation. Uranium minerals include uraninite, uranopilite, johannite, uranophane, and metatorbernite. These occur as replacements of carbonaceous material and as disseminations in sandstone. (auth)

732 (TM-178) MINERALOGY OF THORIUM. Austin, S. R. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). 21 Feb 1962. 16p. GJO.

The mineralogy of thorium is discussed. A list of 64 Th minerals and Th-bearing minerals is included. In addition, a list of synonyms, varieties, and doubtful species is included. (26 references) (JGB)

733 (TM-D-1-11) PRELIMINARY REPORT ON URANIUM-BEARING DEPOSITS OF THE OLLIE–CARLYLE DISTRICT, SOUTHEASTERN MONTANA. Marks, L. Y. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). May 1959. 36p. GJO.

Uranium has been discovered in rocks of the Fort Union Formation of Paleocene age in the Ollie–Carlyle district, southeastern Montana. The host rocks are probably part of the Tongue River member. Where favorable for uranium, they consist of sandy strata containing carbonaceous trash and lignitic beds and lenses, and are underlain by impermeable clays. Structure probably contributed to localization of uranium, as deposits are down dip from local structural highs. The uranium appears to be in equilibrium below the water table but not near the surface. Uranium may be partly in urano-organic compounds or complexes, but metatyuyamunite and possibly meta-autunite have been found in the zone of oxidation near the surface. Ground water is considered to be the agent that deposited and redistributed the uranium, which was possibly leached from tuffaceous rocks of Oligocene and Miocene age. (auth)

734 (TM-D-1-17) URANIUM EXPLORATION IN THE HULETT CREEK AREA, CROOK COUNTY, WYOMING. Gorman, L. A.; MacPherson, B. A. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Sep 1957. 27p. GJO.

Several uranium deposits and radioactive anomalies are located within an area of approximately two square miles at Hulett Creek, in northeastern Wyoming. Field investigations and contract diamond drilling were performed by the Atomic Energy Commission in an attempt to find additional uranium deposits and to determine local ore controls. The mineable deposits and strongest surface anomalies are found in sandstone-filled paleo-channels in the lower Cretaceous Fall River Formation. Ore minerals are of the carnotite-type with small amounts of primary uranium minerals present. Most of the deposits have abundant carbonate and silica-cement associated with them. This same type cementing material is also abundant along the margins of the channels. The Fall River Formation has been uplifted along Hulett Creek, forming a low-angle elongate dome which is marked by many normal faults. A large monoclinal fall lies west of the dome. These major tectonic features strike north and northeast intersecting the local sedimentary trends at about a right angle. Many of the ore deposits were found along these intersections which form loci for ore deposition. In several drill holes, uranium minerals were encountered below the water table in the Lakota Formation. The secondary uranium is associated with organic materials probably in the form of metallo-organic compounds. Uraninite and coffinite are probably also present in the Lakota Formation, but as yet they have not been identified. Carbonaceous material appears to be more abundant where facies changes are prevalent. (auth)

735 (TM-D-5-2) PRELIMINARY REPORT ON RADIOACTIVE MINERAL DEPOSITS IN THE GULF COASTAL PLAIN OF TEXAS AND LOUISIANA, NORTH AND EAST OF THE GUADALUPE RIVER. Blair, R. G. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). Mar 1959. 16p. GJO.

Approximately 30 radioactive mineral deposits are known to occur in the Gulf Coastal Plain of Texas and Louisiana, north and east of the Guadalupe River. A preliminary field examination and sampling of each deposit has been made. The host rocks range in age from lower Eocene to Miocene. Only those localities in northern Gonzales, Fayette, and western Washington Counties, Texas, are likely to produce uranium ore. In these counties, five scattered properties have produced select samples containing more than 0.10% U_3O_8. These samples are from small mineralized lenses within sandy silty lignite beds and sandstone strata of the upper Jackson formation of Eocene age and the lower Catahoula formation of Miocene (?) age. Only incomplete and sporadic surface and subsurface exploration has been attempted; consequently, little is known of the stratigraphic relationships, mineralogy, or size of the uranium deposits. (auth)

736 GEOKHIMIYA URANA V ZONE GIPERGENEZA. (Geochemistry of Uranium in the Hypergenesis Zone). Evseeva, L. S.; Perel'man, A. I.; Ivanov, K. E. Moscow; Atomizdat (1974). 280p.

This book considers the geochemistry of uranium and of a number of natural, radioactive isotopes in various systems of the hypergenesis zone: plains, surface and underground waters, oxidation zones of ore deposits, weathered areas, and catagenesis subzone. The behavior of uranium is considered on the basis of an analysis of its physical-chemical properties, ability to migrate, and details of processes of leaching, transfer, and deposition. A description is given of the forms of finding uranium in minerals and natural waters, and its Clark numbers and Clark concentrations in ores are presented. The regularities in the formation of oreoles and amounts of dispersed uranium near ore deposits are pointed out. On the basis of analyzing the behavior of uranium in the catagenesis subzone, processes of exogenous ore formation are considered: geochemistry of ore deposits, epigenetic (geochemical and hydrochemical) zonality, hydrogeological and physical-chemical conditions of uranium accumulation, and association of minerals and elements. (308 references) (tr-auth)

737 LOWER HURONIAN SANDSTONES; CORRELATION PROBLEMS AND URANIUM, MORIN TOWNSHIP AREA, ONTARIO. Chandler, F. W. (Ontario Ministry of Natural Resources, Toronto). Can. J. Earth Sci.; 12: No. 2, 237-251(Feb 1975).

Huronian feldspathic sandstones 30 km north of Thessalon (the Morin Township area) rest noncomformably upon Archean rocks and are overlain by the Huronian Gowganda Formation. They contain uraniferous pyritic quartz-pebble orthoconglomerate, similar to the uraniferous conglomerate ore of the Elliot Lake–Blind River area. The sandstones also contain paraconglomerate units at several stratigraphic levels which are lithologically similar to the Ramsay Lake and Bruce Formations. Trends in Huronian stratigraphy on the North Shore of Lake Huron suggest that in the Morin Township area the Quirke Lake Group is absent and the McKim and Pecors Formations, which contain much argillite, are likely to be very thin or absent. Thus the feldspathic sandstones of the Morin Township area are assigned to the Matinenda and the Mississagi Formations. The most continuous paraconglomerate unit might be correlated with the Ramsay Lake Formation. Huronian feldspathic sandstones lying nonconformably upon Archean rocks 16 km northeast of Sault Ste Marie (the "Soo Series") and 50 km north of Sudbury, have many features in common with the sequence of the Morin Township area. Stratigraphic subdivision of these two sequences and finer delimitation of potential uraniferous units may be aided by using paraconglomerates such as the Ramsay Lake Formation as marker units. Such subdivision however will be uncertain until the number, exact stratigraphic position and the areal continuity of these paraconglomerates can be assessed better. (auth)

738 PERFIL ANALITICO DO URANIO. (Analytical Profile of Uranium). Maciel, A. C.; Cruz, P. R. Rio de Janeiro; Ministerio das Minas e Energia (1973). 70p.

Geologic and economic aspects of uranium are considered. Uranium minerals, occurrences of uranium in Brazil, prospecting, methods of processing for production of U_3O_8, reserves, and uranium production capacity are discussed. (500 references) (MCG)

739 WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES IN A WELL PUMPING FROM SLIGHTLY FRACTURED CRYSTALLINE ROCK. Marine, I. W. (E. I. du Pont de Nemours and Co., Aiken, SC). Water Resour. Res.; 11: No. 1, 165-173 (Feb 1975).

At the Savannah River plant of the Atomic Energy Commission near Aiken, South Carolina, there are three distinct groundwater systems: the coastal plain sediments, the crystalline metamorphic rocks, and a buried Triassic basin. The coastal plain sediments include several Cretaceous and Tertiary granular aquifers and aquicludes, the total thickness being about 305 m. Below these sediments, water occurs in small fractures in crystalline metamorphic rock (hornblende schist and gneiss with lesser amounts of quartzite). Water level fluctuations due to earth tides are

recorded in the crystalline metamorphic rock system and in the coastal plain sediments. No water level fluctuations due to earth tides have been observed in wells in the Triassic rock because of the very low permeability. The water level fluctuations due to earth tides in the crystalline rock are about 10 cm, and those in the sediments are about 1.8 cm. The use of water level fluctuations due to earth tides to calculate porosity appears to present practical difficulties both in the crystalline metamorphic rock system and in the coastal plain sediments. In a 1-yr pumping test on a well in the crystalline metamorphic rock the flow was controlled to within 0.1 per cent of the total discharge, which was 0.94 l/s. The water level fluctuations due to earth tides in the pumping well were 10 cm, the same as when this well was not being pumped. (auth)

740 RIO ALGOM'S LISBON URANIUM MINE IN UTAH OPENS UP NEW AREA OF ORE POTENTIAL. Jackson, D. Jr. Eng. Mining J.; 176: No. 4, 92-95(Apr 1975).

The development of the modified room-and-pillar mine is discussed. Details of the mill design, including a processing flowsheet, are given. Safety features and the monitoring system of the facility are discussed. (JGB)

741 CONCLUSIONS DRAWN FROM STUDIES ON THE OKLO NATURAL NUCLEAR REACTOR CONCERNING THE EVOLUTION IN THE GROUND OF RADIOACTIVE WASTE OVER A LONG PERIOD. Frejacques, C. Trans. Amer. Nucl. Soc.; 20: 695-696(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

Radioactive Effluents

Refer also to abstracts 778, 1190, 1562, 2434, 2498, and 2907–2909.

742 (HASL-290) FINAL REPORT ON CONTINUOUS MONITORING WITH HIGH PRESSURE ARGON IONIZATION CHAMBERS NEAR THE MILLSTONE POINT BOILING WATER POWER REACTOR. Miller, K. M.; Gogolak, C. V.; Raft, P. D. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). Feb 1975. 27p. Dep. NTIS $4.00.

Measurements employing high-pressure argon ionization chambers have provided a continuous record of the exposure rates at several locations in the vicinity of the Millstone Point boiling water power reactor. Characteristics of the temporal variations of this record over a period of two years have been studied allowing a direct assessment of the reactor-related component of the gamma-radiation environment, as well as an evaluation of naturally-occurring variations in background. (auth)

743 (INIS-mf-1650) RELEASE OF RADIOACTIVE MATERIAL FROM NUCLEAR POWER PLANTS. Report No. 1. Background Data for Elements in Oceanic Water, and Water, Organisms and Sediments in the Oslofjord. Rygg, B. (Norsk Institutt for Vannforskning, Oslo). Jan 1974. 30p. (In Norwegian). INIS.

In order to evaluate the radioecological effects of effluents from a nuclear power plant to coastal waters, it is necessary to have a description of the recipient's original state. Existing data is presented here for the normal concentrations of elements in ocean water, and their concentrations in water, organisms, and sediments in the Oslofjord. Of the latter three environmental components, the sediments are the best known. Knowledge of the various elements in the water and especially in organisms is insufficient to calculate concentration factors specifically for the Oslofjord. (INIS)

744 (INIS-mf-1653) NUCLEAR POWER PLANT BY THE OSLOFJORD. Introductory Radioecological Studies. (Norges Vassdrags- og Elektrisitetsvesen, Oslo. Direktoratet for Statskraftverkene). Jan 1974. 178p. (In Norweigan). INIS.

Calculated radiation doses are presented for individuals in nominal critical groups, resulting from releases of radioactive materials to the atmosphere and to the cooling water recipient from a nuclear power plant. The calculations include internal doses from food contaminated by atmospheric releases and by cooling water together with external doses from releases to the cooling water recipient. The nominal collective doses to the thyroids of children from radioactive iodine in milk has also been calculated. An evaluation has also been made of the extent of contamination following a reactor accident. It is pointed out that in interpreting the calculated results it should be borne in mind that the data used is partly incomplete, especially regarding the amount and composition of the releases and the population's use of the food resources. Direct radiation from the release of inert gases to the atmosphere and radiation doses from the inhalation of radioactive materials is not considered in this report. (INIS)

745 (UCRL-51765) RAIN SCAVENGING OF RADIOACTIVE PARTICLES. Williams, A. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1975. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

An assessment is made of the rainout of airborne radioactive particles from a nuclear detonation with emphasis on the microphysical removal processes. For submicron particles the scavenging processes examined are Brownian and turbulent diffusion to cloud droplets. For particles larger than 1 mu m radius, nucleation scavenging is examined. For various particle size and radioactivity distributions, it is found that from 27 to 99 percent of the radioactivity is attached to cloud droplets and subject to rapid removal by rain. (auth)

746 (UNI-349) UNITED NUCLEAR INDUSTRIES, INC. REACTOR AND FUEL PRODUCTION FACILITIES 1974 ENVIRONMENTAL RELEASE REPORT. Cucchiara, A. L. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 14 Mar 1975. Contract AT(45-1)-1857. 24p. Dep. NTIS $4.25.

During calendar year 1974, an estimated total of 3,000,000 pounds of waste materials, including approximately 200 curies of radionuclides, were discharged to the environs in liquid effluent streams emanating from United Nuclear Industries, Inc., operated facilities. During the same period, approximately 2,000,000 pounds of reported waste materials, including 50,000 curies of reported radionuclides, were discharged to the atmosphere from United Nuclear Industries, Inc., operated facilities. (auth)

747 RADIOLOGICAL PROBLEMS OF LIQUID WASTE DISPOSAL INTO THE SEA. Martin, J. J.; Boissonnet, B. Trans. Amer. Nucl. Soc.; 20: 423-424(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

748 PREOPERATIONAL INVESTIGATION OF SAFE RADIOACTIVE RELEASES FROM A NUCLEAR POWER SITE. Basson, J. K.; van As, D. Trans. Amer. Nucl. Soc.; 20: 429-431 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

749 ENVIRONMENTAL INFLUENCES OF THE HTGR. Baust, E.; Gabriel, H. W.; Schueller, K. H. Trans. Amer. Nucl. Soc.; 20: 442(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

750 THE EFFECT OF COOLING TOWERS ON THE ATMOSPHERIC PROPAGATION OF RADIOACTIVE OFF-GASES. Fuchs, H. (Motor-Columbus Ingenieurunternehmung A. G., Baden (Switzerland)). VGB Kraftwerkstechnik; 54: No. 12, 825-827(Dec 1974). (In German).

On the basis of wind tunnel studies it is found that the presence of a cooling tower may slightly increase the concentration at ground level of activities discharged through the stack in the immediate vicinity, if the intensity and direction of the wind favor such phenomenon. As a rule, however, this increase involves no problems if the heights of the stacks are designed accordingly. On the basis of detailed studies, for instance, the authorities requested a stack height of 100 m for the Goesgen Nuclear Power Station. (GE)

Radioactivity Monitoring and Transport

Refer also to abstracts 867, 1130, and 2924.

751 (ANL-75-18) ENVIRONMENTAL MONITORING AT ARGONNE NATIONAL LABORATORY. Annual Report for 1974. Sedlet, J.; Golchert, N. W.; Duffy, T. L. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 78p. Dep. NTIS $5.45.

The results of the environmental monitoring program at Argonne National Laboratory for 1974 are presented and discussed. To evaluate the effect of Argonne operations on the environment, measurements were made for a variety of radionuclides in air, surface water, Argonne effluent water, soil, grass, benthos, and milk; for a variety of chemical constituents in surface and Argonne effluent water; and of the environmental penetrating radiation dose. Sample collections and measurements were made at the site

boundary and off the Argonne site for comparison purposes. Some on-site measurements were made to aid in the interpretation of the boundary and off-site data. The results of the program are interpreted in terms of the sources and origin of the radioactive and chemical substances (natural, fallout, Argonne, and other) and are compared with accepted environmental quality standards. The potential radiation dose to off-site population groups is also estimated. (auth)

752 (FFIF-F-596) MEASUREMENT OF CESIUM-137 IN HUMAN BLOOD FROM KAUTOKEINO AND FROEYLANDSDAL, 1971. Olving, J. H. (Forsvarets Forskningsinstitutt, Kjeller (Norwary)). Jan 1974. 18p. INIS.

Measurements were made of cesium-137 in the blood of 26 persons, 14 Lapps from Kautokeino, 2 persons from Lofoten, and 10 from W. Norway. The results show, as expected, that the reindeer herding Lapps have a much higher cesium-137 values than the others, and that, after corrections for changes in the sample basis, all show reductions of about 40% from the previous year. Corrections for the time interval and seasonal variations lead to an annual activity reduction of about 20%. The cesium-137 in blood values were related to the measured body burdens of the Lapps, and the $^{55}Fe/^{137}Cs$ ratio was measured, but the scatter and the small number give too poor a basis to draw conclusions. (INIS)

753 (LBL-3821) ANNUAL ENVIRONMENTAL MONITORING REPORT, 1974. Stephens, L. D.; Cantelow, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-eng-48. 50p. Dep. NTIS $5.45.

The Lawrence Berkeley Laboratory, a large multi-disciplinary research institute, is located in the hills above the University of California and the City of Berkeley. Nuclear Physics and Nuclear Chemistry research are the main contributors to the environmental radiation. In order to pursue this research effort, large particle accelerators have been built and are operated almost continuously. Other research may also involve the use of radioisotopes. These research activities result in a small but finite population dose to the general population which works or resides in the area surrounding the Laboratory. The annual maximum permissible dose equivalent (MPD) for members of the general population is recommended to be 500 mrem, however, Laboratory policy is to keep the population exposure as low as practicable at all times. In order to assure that this is done, several environmental monitoring stations are maintained which continuously telemeter radiation information to a central location. This information is presented here along with studies of the population distribution, in order to provide a total man-rem estimate. Using the data in this report the population dose due to laboratory operation ranges from 0.4 percent to 5.7 percent of the MPD. (auth)

754 (PNE-RB-63) PROJECT RIO BLANCO RADIOACTIVITY AND THE ENVIRONMENT. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). 3 Mar 1975. 39p. Dep. NTIS $5.00.

Results are presented of measurement of releases of radioactivity to the environment in connection with the drawdown testing of the upper chimney created by the Project Rio Blanco nuclear gas stimulation experiment in the emplacement well. Data obtained in radiological measurements of the environment and in documenting the transfer to a subsurface disposal well of tritiated water separated during production of gas are also included. Data are presented for concentrations of ^{37}Ar, ^{39}Ar, ^{85}Kr, ^{131}Xe, ^{3}H, and ^{14}C. (HLW)

755 (RISO-303) COMPUTER MODELLING OF TERRESTRIAL GAMMA-RADIATION FIELDS. Kirkegaard, P.; Loevborg, L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1974. 88p. Dep. NTIS (US Sales Only) $7.50.

The plane, one-dimensional photon transport equation is considered in the case of two adjacent media, where one medium contains the γ sources and the other is inactive. Assuming that the sources have a composite line spectrum, and that they are uniformly distributed, an explicit solution is given for the uncollided flux component. The scattered component is evaluated on the basis of the double-P_1 approximation, involving separate treatments of the upstreaming and the downstreaming flux, and a numerical method for solution of the corresponding equations is presented. The computational method permits determination of the differential and angular energy flux throughout the inactive medium. Formulas for obtaining integral field quantities (scalar energy flux, scalar number flux, and absorbed dose rate) are given. The flux calculation method is used in conjunction with a computer data processing system (GAMMABANK) for evaluation of terrestrial gamma-radiation fields. A detailed description is given of both the data files and the programs of which the system consists. To illustrate the performance of the system, results obtained for the radiation field in water above sand are presented. (auth)

756 (SCP-2.28.05-3) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT. Prospective Site: Saga (Porsgrunn). Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). Aug 1974. 88p. (In Norwegian). Dep. NTIS (US Sales Only) $7.50.

Atmospheric dispersion is calculated on the basis of meteorological data for the Saga (Porsgrunn) prospective nuclear power plant site on the Oslofjord. Releases of radioactive materials from both BWR and PWR type reactors under normal operation and following loss of coolant accidents (two for each reactor type, corresponding to different assumptions of conditions following the accident) together with population data are then used to calculate the resulting radiation doses. Population doses under normal operation with a stack height of 100 m are, for a BWR 0,72 manrem/yr based on the 1972 population statistics and 1,7 manrem/yr based on the population prognosis for 2000. Corresponding doses for a PWR are 0,11 manrem/yr and 0,19 manrem/yr. Following a loss of coolant accident, using the meteorological data as prescribed in the US guidelines the individual doses for two different conditions are, for a BWR, two-hour dose at 1 km, whole body 0,51 rem and 0,02 rem and thyroid 1,0 (adult) and 0,13 (child), 30 day dose at 3 km whole body dose 1,6 rem and 0,12 rem and thyroid dose 4,8 rem (adult) and 3,8 rem (child). The corresponding doses for a PWR are virtually the same. (NO)

757 (SCPRI(RM)-7-1974(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection Contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Jul 1974. 21p. (In French). INIS.

Measurement tables concerning the surveillance of the environment are included (see also the SCPRI-RM-7-1974 report). (FR)

758 (UCRL-50027-74) ENVIRONMENTAL MONITORING AT THE LAWRENCE LIVERMORE LABORATORY, 1974 Annual Report. Silver, W. J.; Lindeken, C. L.; Meadows, J. W.; Willes, E. H.; McIntyre, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Contract W-7405-eng-48. 53p. Dep. NTIS $5.45.

In 1974, the average annual gross beta activity on particulate air filters was about five times higher than in 1973. This increase is due almost entirely to the nuclear debris added to the stratosphere by the large-yield Chinese atmospheric event of June 27, 1973. There were corresponding increases in specific fission-product radionuclides. Airborne ^{238}U concentrations at Site 300 were higher than those at Laboratory perimeters due to the use of depleted uranium (a byproduct of ^{235}U enrichment) at the Site. These uranium concentrations were well below the standards set by the AEC. Soil samples collected in the off-site vicinity of the Laboratory and at Site 300 were analyzed for plutonium. There were negligible changes from the levels reported in 1973. Water samples collected within the Livermore Valley and Site 300 exhibited normal background gross beta and tritium activities. Vegetation samples collected in areas generally downwind from the Laboratory contained tritium activities 10 to 100 times higher than those collected in areas where the Laboratory's contribution should be minimal. There were also two locations at Site 300 at which tritium levels in vegetation were above background. In all cases if this vegetation were a regular part of one's diet, the annual whole-body radiation dose from tritium would be less than 1 mrem. The average annual gamma dose rate at Laboratory perimeters was 74 mrem. In the off-site vicinity, the average annual background dose rate was 68 mrem. Both Laboratory perimeter and Site 300 annual average airborne beryllium concentrations were less than 1 percent of the appropriate standard. Releases of heavy metals to the Livermore sanitary sewer system conformed to the discharge regulations of the City of Livermore. No Laboratory effluent resulted in estimated radiation doses to the public exceeding 5 mrem. Assessment of the radiation doses to an individual from the environmental activities listed in this report demonstrates that the dose contribution from Laboratory operations in 1974 was small compared with the approximately 100 mrem per year dose received from natural sources. (auth)

759 ENVIRONMENTAL RADIOACTIVITY IN THE YEAR 1973. At. Inform.; No. 10, 6-7(1974). (In German).

Radiation monitoring in the environment of nuclear power plants and other nuclear facilities in 1973 showed no noticeable difference between values measured in the environment of these facilities and those measured elsewhere. In no case was the maximum permissible limit reached or exceeded. (GE)

760 TERRESTRIAL GAMMA-RAY SURVEYS AT PREOPERATIONAL NUCLEAR POWER PLANTS USING AN IN-SITU

Ge(Li) SPECTROMETER. Ragaini, R. C.; Jones, D.; Hukabay, G. W.; Todachine, T. (Lawrence Livermore Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 636-641(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

As a prelude to in-situ measurements of gamma exposure rates from reactor plumes, baseline terrestrial gamma-ray surveys have been run at five preoperational nuclear power stations: Fort St. Vrain, Colorado; Fort Calhoun, Nebraska; Cooper Nuclear Station, Nebraska; Rancho Seco, California, and Diablo Canyon, California. A pressurized ion chamber was used to measure the total exposure from cosmic rays and terrestrial radionuclides. A portable Ge(Li) spectrometer was used to make in-situ measurements of the radionuclide soil concentrations and of the individual external gamma exposure rates at the TLD sites. Subsequent measurements after start-up will enable accurate determinations of deposition and buildup of reactor produced fission products to be made. The application of the in-situ Ge(Li) spectrometer for real-time plume dose measurements is being investigated. (auth)

761 ABOUT THE SOMATIC RISK CAUSED BY IONIZING RADIATION AND CHEMICALS IN OUR ENVIRONMENT. Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Atomkernenergie; 24: No. 4, 217-223(1974). (In German).

From annual meeting 1974 of the Fachverband fuer Strahlenschutz e.V.; Helgoland, F. R. Germany (23 Sep 1974).

A review about the types and importance of the somatic effects from ionizing radiation and chemicals in our environment is given. Especially the analogies and differences between both kinds of agents are outlined, which exist with respect to dose-effect-relationships and the concepts for the assessment of exposure limits for the population. Contrary to the case of radiation, our present knowledge enables no quantitative estimation of the somatic population risk by environmental chemicals. (auth)

762 HEALTH PROTECTION AND THE CONTROL OF ENVIRONMENTAL RADIOACTIVE POLLUTION. Cigna, A. A.; Faloci, C.; Polvani, C. Com. Naz. Energ. Nucl., Notiz.; 20: No. 2, 25-39(Feb 1974). (In Italian).

The very low degree of the environmental radioactive contamination existing in Italy is evidenced in the report, together with the research and surveillance actions underway. After reviewing the main contamination sources and the meaning of the health and environmental standards of radiation protection, the organisation of controls in Italy is described with particular reference to the national and local sampling networks, the measurement centers, the number and type of measurements performed, and the wide spreading of the publications concerning the results, carried out by CNEN. Intake evaluations by the average individual in the Italian population for some fallout radionuclides during the last 20 years, are reported. (auth)

Atmosphere

Refer also to abstracts 146 and 805.

763 (SAAS-168) PHYSICAL PROBLEMS IN MEASURING THE EXPOSURE RATE OVER A CONTAMINATED AREA FROM THE AIR. Eiteljoerge, N.; Schuricht, V. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Oct 1974. 49p. (In German). Dep. NTIS (US Sales Only) $5.50.

The most rapid method of assessing the contamination of an area caused by a reactor accident or nuclear explosion is monitoring from an aircraft. To transform the values measured at an altitude h to the exposure rate at the height of 1 m altitude correction factors are needed. Further factors considering soil surface structure, chemical composition of soil and air, fallout distribution, and extent of the area concerned can only be calculated for simple cases. The most exact results are obtained by monitoring from a helicopter at altitudes of less than 100 m. However, to achieve this, expensive monitoring systems with board computer are necessary. (tr-auth)

764 (UCRL-13624-1) VERTICAL TRANSPORT OF DESERT PARTICULATES BY DUST DEVILS AND CLEAR THERMALS. Sinclair, P. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 53p. Dep. NTIS $5.75.

While the vertical and horizontal transport of natural surface material by dust devils is not in itself a critical environmental problem, the transport and downwind fallout of toxic or hazardous materials from dust devil activity may be a contributing factor in the development of future ecological-biological problems. Direct quantitative measurements of the dust particle size distribution near and within the visible dust devil vortex and analyses of the upper level clear thermal plume have been made to provide estimates of the vertical and horizontal transport of long half-life radioactive substances such as plutonium. Preliminary measurements and calculations of dust concentrations within dust devils indicate that over 7 x 10^3 tons of desert dust and sand may be transported downwind from an area 285 km^2 during an average dust devil season (May to August). Near the ground these dust concentrations contain particles in the size range from approximately 1 mum to 250 mum diameter. Since the vertical velocity distribution greatly exceeds the particle(s) fall velocities, the detrainment of particles within the vortex is controlled primarily by the spatial distribution of the radial (v/sub r/) and tangential (v/sub theta/) velocity fields. Above the visible dust devil vortex, a clear thermal plume may extend upward to 15,000 to 18,000 ft MSL. A new airborne sampling and air data system has been developed to provide direct measurements of the dust concentration and air motion near and within the upper thermal plume. The air sampler has been designed to operate isokinetically over a considerable portion of the low-speed flight regime of a light aircraft. A strapped down, gyro-reference platform and a boom-vane system is used to determine the vertical air motions as well as the temperature and turbulence structure within the thermal plume. (auth)

765 TWO EXPERIMENTAL METHODS OF ANALYSIS IN REAL TIME OF DISPERSION FROM A POINT SOURCE. Druilhet, A.; Guedalia, D.; Rouzaud, B.; Boyer, J. M.; Pontan, J. (Univ., Toulouse). Atmos. Environ.; 9: No. 2, 201-209(Feb 1975).

Two experimental methods of investigation of atmospheric diffusion in real time are proposed. The first method is based on the use of a short lived radioactive gas, thoron ($T\frac{1}{2}$ = 54 sec). This gas is particularly well adapted to the study of small scale diffusion (from 0 to 1 km); the second method uses zinc cadmium sulfide as a tracer. Compared with the preceding applications, the detection technique was simplified. The (Zn, Cd)S allows diffusion studies at a larger scale than the preceding tracer. The time constant of detection ranges about one second, which is of course interesting for the study in real time of atmospheric diffusion. As the samples are of very simple construction, it is planned to multiply their number for an experiment. As an example, the two techniques can be used together for the study of the deposition of aerosols. (auth)

Soil

Refer also to abstract 1560.

766 SOIL CONTAMINATION. Li, T. C. Ti-li Chih-shih; No. 1, 30-32(Jan 1974).

When poisonous material accumulates in soil, it directly affects the growing of agricultural crops, which in turn are eaten by man with harmful effects on his health. Substances causing soil contamination include pesticides, heavy metals, organic contaminants, radioactive substances, excessive fertilizer, and bacteria. The heavy metals causing contamination are cadmium, chromium, copper, lead, zinc, manganese, nickel, mercury, and arsenic. Harmful organic compounds include phenols, cyanides, and oils, originating in the waste industrial water from petrochemical, coking, chemical, and electroplating plants. Generally, the concentrations of contaminants in soil are low; however, on climbing the food chain, the concentrations gradually rise. At the last stage of the food chain, man consumes food with the highest concentration of these toxic materials. (JPRS)

Water

767 (DP-MS-74-53) POLLUTANT TRANSPORT IN NATURAL STREAMS. Buckner, M. R.; Hayes, D. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 17p. (CONF-750406-2). Dep. NTIS $4.00.

From ANS topical meeting on computational methods in nuclear engineering; Charleston, South Carolina, USA (15 Apr 1975).

A mathematical model was developed to estimate the downstream effect of pollutant releases to tributary streams and rivers. The one-dimensional dispersion model was employed along with a dead zone model to describe stream transport behavior. Options are provided for sorption/desorption, ion exchange, and particle deposition in the river. The model equations are solved numerically by the LODIPS computer code. The solution method was verified by application to actual and simulated releases of radionuclides and other chemical pollutants. (auth)

768 ENVIRONMENTAL EXPOSURE BY TRITIUM. Koenig, L. A.; Winter, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). KFK Nachr.; 6: No. 3, 33-38(1974). (In German).

The causes of T contamination are briefly explained: natural production; nuclear arms tests; operation of nuclear reactors and reprocessing plants; and luminous colors and β-light sources. The T control program in the close and distant vicinity of the nuclear research centre Karlsruhe for the determination of the content in ground, drinking, and surface water as well as in rainfall is described and a few measured data are given. (GE)

Ecosystems and Food Cycles

Refer also to abstracts 176, 865, and 1216.

769 (INIS-mf-1704) INVESTIGATIONS OF RADIOACTIVE FALLOUT IN HUMANS AND FOODSTUFFS IN NORWAY. Annual Report. Christensen, G. C.; Pappas, A. C. (Oslo Univ. (Norway)). Feb 1974. 38p. INIS.

Results of measurements of ^{90}Sr in human bone from subjects who died in the years 1972 and 1973, of ^{90}Sr and ^{137}Cs in Norwegian cheese, and ^{90}Sr in Norwegian produced vegetables and corn in 1972 and 1973 are presented. All levels appear now to be relatively constant. (INIS)

770 (SREL-1) BIBLIOGRAPHY OF AQUATIC AND THERMAL STUDIES CONDUCTED ON THE SAVANNAH RIVER PLANT. Murphy, J. C.; Gibbons, J. W. (Savannah River Ecology Lab., Aiken, S.C. (USA)). [nd]. Contract AT(38-1)-819. 25p. Dep. NTIS $4.25.

The bibliography contains 105 references covering all of the published research performed in the aquatic areas of the Savannah River Plant since its inception in 1951. Each paper has been categorized on the basis of the type and location of the study. (ERB)

Radiometric Techniques

Refer also to abstract 765.

771 (COO-3427-10) NUCLEAR CHEMISTRY RESEARCH. Annual Progress Report, 1 January 1974–31 December 1974. Wolke, R. L. (Pittsburgh Univ., Pa. (USA). Wherrett Lab. of Nuclear Chemistry). 1974. Contract AT(11-1)-3427. 32p. Dep. NTIS $4.75.

The charge-state program was directed toward heavier ions than had been studied previously. The low-level counting program was continued in two projects: a search for natural alpha radioactivity in osmium and a search for strontium activity in marine mollusc shells. In parallel with the latter work, a comprehensive literature review was made of the applications of radiochemistry to oceanographic research. A new, non-experimental project was begun: a general, consistent mathematical analysis of low-level counting statistics. Improvements in facilities and equipment are reported. (auth)

772 (INIS-mf-1647) RADIOACTIVE TRACERS FOR USE IN GROUND WATER INVESTIGATIONS. Skaugrud, O. (Oslo Univ. (Norway)). 1974. 108p. (In Norwegian). INIS.

Following a discussion of the use of radioactive tracers in groundwater investigations, their transport and dispersion, sorption and their selection, and a list of tracers previously used, the techniques of the injection of radioactive tracers in determining groundwater profiles, velocity, and direction are described. Thereafter a detailed investigation of the suitability of $^{24}Na^+$ and $^{82}Br^-$ (half lives 15 hrs and 35 hrs respectively) is made. These were chosen as few investigations have been made on tracers with relatively short half lives. Sorption of those two tracers and also ^{51}Cr-EDTA in quartz and feltspat sands has been investigated experimentally. Field investigations of $^{24}Na^+$ and $^{82}Br^-$ have also been carried out and the results are presented and discussed. The conclusion is that $^{24}Na^+$ is well suited as a tracer for profile and directional measurements, but less well suited for velocity measurements, while $^{82}Br^-$ is well suited for profile, directional, and velocity measurements. (INIS)

773 (TID-3920) NUCLEAR TECHNOLOGY IN ARCHAEOLOGY: PARTIAL BIBLIOGRAPHY. Schultz, S. L.; Schultz, V. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). 1975. 54p. Dep. NTIS $5.45.

The bibliography contains citations to the literature on the use of such nuclear techniques as neutron activation analysis, x-ray fluorescence analysis, radiation scattering analysis, isotope dating, fission track dating, and thermoluminescence in determining the age of archeological materials. (ERB)

774 GAMMA-RAY ABSORPTION IN GRANODIORITE. Vankova, V. (Geophysical Inst., Prague). Stud. Geophys. Geod.; 18: No. 4, 367-369(1974).

The coefficient of gamma absorption $\mu_{C_s}{}^{137}$ of the Blatná-type granodiorite from the Central Bohemian Pluton was investigated. (auth)

775 DETERMINATION OF THE AGE OF NATURAL WATERS ACCORDING TO COSMOGENIC AND ARTIFICIAL ^{22}Na. Fleishman, D. G.; Kanevskii, Yu. P.; Gritchenko, Z. G. (Inst. of Radium, Leningrad). Geokhimiya; No. 2, 280-290(Feb 1975). (In Russian).

The possibility of using natural ^{22}Na for radioisotopic dating of young (no more than 100 years) surface and underground waters has been considered and theoretically grounded. Data of many years on atmospheric fallouts of cosmogenic and artificial ^{22}Na in the environs of Leningrad (1960–1972) and on concentrations of this radionuclide in waters of some rivers and lakes of the European and Asiatic parts of the USSR are given. The values of the ages of the investigated water masses were calculated according to experimental data and a good agreement between the obtained results and the dating according to hydrological parameters and to tritium was established on the example of the great lakes of Europe. (auth)

776 EXPLORATION OF MARINE ORE DEPOSITS UTILIZING SPECTROSCOPY OF NEUTRON-INDUCED γ RADIATION. Fanger, H. U.; Pepelnik, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Kernphysik). Ind. At. Spatiales; 18: No. 4, 68-84(Jul 1974). (In English and French).

For the exact determination of extension and quality of marine ore fields, in situ methods of analysis are the most attractive. Neutron capture γ spectroscopy is a useful tool for multi-element analysis of manganese nodules on the sea-floor. The principle of this method, the geometry of analysis, and the accuracy obtainable are discussed. In addition, a concept for the technical realization of the (n,γ) analysis method is indicated. (FR)

Site Surveys

777 (BMI-171-152) AMCHITKA BIOENVIRONMENTAL PROGRAM. Geomorphology and Plant Ecology: An Assessment of the Impact of AEC Nuclear Test on Amchitka. Everett, K. R.; Amundsen, C. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. Contract AT(26-1)-171. 70p. Dep. NTIS $5.45.

The U. S. Atomic Energy Commission's underground nuclear testing on Amchitka has included two nuclear detonations: Milrow (about 1-megaton) in October 1969, and Cannikin (a little less than 5-megatons) in November 1971. This report assesses the impact of these tests on the basis of information collected since 1967 and through the 1973 growing season. To make these assessments and predictions realistic it was necessary to develop general descriptions of Amchitka's geomorphology, terrestrial plant ecology, and physical environment; and to assess the effects of man's previous use of the Island through World War II and the DOD Long Shot test. Mapping methods and methods for plant-community and soil-type studies and definitions are described because they were used to predict vegetative recovery on disturbed areas which are shown to have their counterparts as a consequence of the Island's natural landscape dynamics. Four annotated plates, covering the study area (45 percent of the Island), show disturbances (1) before 1948, (2) 1948 to 1969 before Milrow, (3) Milrow to 1971 before Cannikin, and (4) during 1971 after Cannikin. A fifth plate shows the plant-community distribution in the study area. While classic sequential plant succession cannot be demonstrated on Amchitka, revegetation in disturbed areas, more properly described as recovery, is described for the various disturbances of terrain and vegetation cover. The photographs are keyed to indicate recovery time from date indicated, type of disturbance, and expected plant-community shift, as well as type of newly exposed or flooded substrate, drainage shifts, and other shock-related phenomena. (auth)

778 (INIS-mf-1706) NUCLEAR POWER PLANT BY THE OSLOFJORD. Introductory Radioecological Studies. Garder, K.; Loeken, P. C. (Norges Vassdrags- og Elektrisitetsvesen, Oslo. Direktoratet for Statskraftverkene). Jan 1974. 178p. (In Norwegian). INIS.

Radiation doses to individuals in nominal critical groups resulting from release of radioactive materials to the atmosphere and to the cooling water recipient from a nuclear power plant

in the Oslofjord district have been calculated. Both internal doses resulting from consumption of food stuffs contaminated by releases to the atmosphere and to the cooling water recipient and external doses from releases to the cooling water recipient are considered. Nominal collective doses to the thyroids of children from radioactive iodine in milk are also presented. Direct radiation from the release of inert gases to the atmosphere and from the inhalation of radioactive materials are treated in a separate report. The results are presented in a number of tables, maps and figures. (INIS)

779 (PRNC-178) LA CHALUPA MISSION NO. 12. Final Report. Castro, R.; Davis, P. H.; Kimmel, J. J.; Purcell, T. W.; Rivera, J. A. (Puerto Rico Nuclear Center, Mayaguez). Mar 1975. Contract AT(40-1)-1833. 46p. Dep. NTIS $5.50.

The Islote area on the north coast of Puerto Rico, approximately 7.5 miles east of Arecibo, is under consideration as a nuclear power plant site. The Puerto Rico Nuclear Center (PRNC) has been contracted since 1973 to collect both physical and biological baseline data on the marine environment at this site. Programs have been initiated to investigate the ichthyofauna, benthic invertebrates and algae, phytoplankton, zooplankton, and the physical environment. The underwater habitat, La Chalupa, was made available for 16 days in May and June 1974. This facility allowed PRNC staff an opportunity to evaluate the ecology of the area from a different perspective, the bottom of the ocean. A team of two invertebrate zoologists, one ichthyologist, and one phytoplanktologist entered La Chalupa which was positioned approximately 900 meters offshore in 22 meters of water. The team had access to 4×10^4 m^2 of bottom for the duration of the mission. Within this area, different habitats were determined, observations were made, and samples were collected. The three other team members provided support for the aquanauts. The relative distribution of the dominant benthic flora and fauna was studied. The ecological relationships of several commercially valuable organisms such as conch, lobster, and crabs were investigated. The bottom was first mapped and subareas were designated for sample collection. Several physical parameters (sedimentation, sediment transport, and currents) were considered in relation to animal distribution. The PRNC-PRWRA ichthyology program began in June 1973. Fish traps, surface and bottom gill nets, spear guns, and rotenone fish poison had been used for sampling from the R/V Sultana. With the aid of La Chalupa most fishes could be observed, including those not previously captured, and their abundance and importance in the area estimated. At the same time, the efficiency of fish traps as a continuous sampling device was evaluated first hand. The phytoplanktologist gathered data during the mission to provide supplemental information to the phytoplankton survey of the area in the form of: identification of populations and major species near the bottom; determination of changes which might occur in the populations as a result of tidal influences or time of day; and determination of a crude idea of productivity in the study area by use of cell counts, chlorophyll measurements, and dark-light bottle studies. This was the first research team to use La Chalupa for continuous survey work within an existing program. Therefore, evaluation of the facility as a survey tool is presented. Tables are presented of species lists of benthic organisms, fishes, and phytoplankton. (HLW)

780 (UCRL-51769) RELATIONSHIP OF MATERIAL PROPERTIES TO SEISMIC COUPLING. Part I. Shock Wave Studies of Rock and Rock-Like Materials. Larson, D. B.; Rodean, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $5.45.

Our research seeks an understanding of the relationship of material properties to explosive-energy coupling in various earth media by integrating experimental observations with computer calculational models to obtain a predictive capability. The procedure chosen consists of: first, selecting materials exhibiting interesting values of the properties that are believed to control coupling; second, experimentally determining material behavior under various types of loading and unloading; third, development of constitutive relationships; fourth, adapting these constitutive relationships to computer calculational models; and fifth, verifying the calculational models through comparison with small-scale and field high-strain-rate experiments. The object of this report is to present the shock-wave data and to make a preliminary evaluation of the results in terms of material properties, coupling, and their interactions. (auth)

781 NUCLEAR SITING IN FRANCE: GENERAL SAFETY AND PROTECTION PRINCIPLES AND RESULTS FROM RECENT STUDIES. Candes, P.; Coulon, R.; Doury, A. Trans. Amer. Nucl. Soc.; 20: 427-429(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

782 METEOROLOGICAL SITE CATEGORIES IN THE FEDERAL REPUBLIC OF GERMANY AS A BASIS FOR ENVIRONMENTAL FORECASTS FOR NUCLEAR PLANTS. Brenk, D.; Vogt, K. J. Trans. Amer. Nucl. Soc.; 20: 436-439(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

Thermal Effluents

Refer also to abstracts 749, 764, and 770.

783 (BNWL-SA-5344) SOME EFFECTS OF TEMPERATURE, CHLORINE, AND COPPER ON THE SURVIVAL AND GROWTH OF THE COON STRIPE SHRIMP, PANDALUS DANAE. Gibson, C. I.; Thatcher, T. O.; Apts, C. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. 16p. Dep. NTIS $4.00.

The CTM (Critical Thermal Maxima) values for coon stripe shrimp increase with an increase in shrimp size. The CTM values for coon strip shrimp increase with an increase in the rate at which the temperature is elevated. Coon stripe shrimp are more resistant to chlorine when acclimated and exposed at 7.5°C-10°C than (a) when acclimated at 7.5°C and exposed at 15°C or 20°C, or when (b) acclimated and exposed at 15°C which is near their optimum short-term growth temperature (16°C). The optimal growing temperature for (1 to 7g) coon stripe shrimp for periods up to one month is 16°C. Copper at a concentration of 0.04 mg/l effectively retards the growth of (1-2g) coon stripe shrimp at 16°C over a one-month period. Chlorine at a concentration of 0.18 mg/l is lethal to (1-2g) coon stripe shrimp at 16°C and reduced their growth at 0.08 mg/l over a one-month period. (auth)

784 (CONF-750425-2) ROOTING AND EARLY GROWTH OF RED MANGROVE SEEDLINGS FROM THERMALLY STRESSED TREES. Banus, M. D.; Kolehmainen, S. E. (Puerto Rico Nuclear Center, Mayaguez). [nd]. 31p. Dep. NTIS $4.75.

From 2nd thermal ecology symposium; Augusta, Georgia, USA (2 Apr 1975).

At Guayanilla on the south coast of Puerto Rico a fossil fueled electric generating station of 1100 MW(e) discharges its cooling water into a nearly enclosed lagoon of about 25 hectares area. The plume and lagoon typically have water temperatures 10°C and 8°C above ambient so that the winter and summer lagoon temperatures are 34 and 39°C, respectively. The north, east, and south shores of this lagoon have extensive stands of red and black mangrove trees which are visibly stressed by the elevated temperatures. Ripe red mangrove seedlings from the bearing trees are significantly smaller than those from trees in Guayanilla Bay not thermally stressed and in unpolluted bays from western Puerto Rico. Seedlings from thermally stressed trees developed negative buoyancy and initial roots faster but first pair of leaves slower than seedlings from control areas. This behavior will be discussed in relation to the propagation of seedlings from non-stressed areas. (auth)

785 (CONF-750425-4) SURVIVAL OF JUVENILE FISHES RECEIVING THERMAL AND MECHANICAL STRESSES IN A SIMULATED POWER PLANT CONDENSER. Kedl, R. J.; Coutant, C. C. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 39p. Dep. NTIS $5.00.

From 2nd thermal ecology symposium; Augusta, Georgia, USA (2 Apr 1975).

Experiments were conducted in a water-recirculating loop to determine the effects of fluid-induced stresses (e.g., turbulence, pressure, and vacuum) on six species of larval fish and one species each of frog tadpoles and zooplankton. These stresses simulate the insults developed in the condenser portion, but not including the pump, of a steam power plant. Some experiments were conducted with thermal stresses superimposed on fluid-induced stresses. Fluid-induced stresses of the magnitude developed in these experiments were generally not fatal to the larval fish within the precision of the experiments, although some sublethal effects were noted. When thermal stress was superimposed on the fluid-induced stresses, the mortalities were equivalent to those resulting from thermal stress alone. Fluid-induced stresses of low magnitude were not fatal to Daphnia magna, but fluid-induced stresses of higher magnitude were responsible for significant mortalities. (auth)

786 (CONF-750425-5) THERMAL TOLERANCE OF THE ADULT ASIATIC CLAM CORBICULA MANILENSIS (MOLLUSCA: BIVALVIA). Mattice, J. S.; Dye, L. L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 32p. Dep. NTIS $4.75.

From 2nd thermal ecology symposium; Augusta, Georgia, USA (2 Apr 1975).

Knowledge of the thermal tolerance of Corbicula manilensis is

important for antifouling at water intakes and protection below discharges. Groups of 20 clams were acclimated to temperatures ranging between 5 and 32°C and exposed continuously to higher temperatures (24-39°C), continuously to lower temperatures (2 to 20°C), or for 30 minutes to temperatures between 37 and 43°C. Mortality was determined by lack of response to prying open the valves. Exposure to temperatures between 40 (5°C Acclimation) and 43°C (30°C Acclimation) for 30 minutes caused 100 per cent mortality. For continuous exposures, upper tolerance limits (50 per cent) were between 24 (5°C Acclimation) and 34°C (30° Acclimation) and lower tolerance limits were between 2 (15°C Acclimation) and 12°C (30°C Acclimation). Relationships between acclimation and resistance temperatures were linear. The upper incipient lethal temperature was 34°C. Use of results at 24 and 48 hours (and 96 hours for long-term heat stress) yielded significant overestimates of tolerance limits. (auth)

787 (CONF-750425-6) EFFECT OF TEMPERATURE ON GROWTH, MORTALITY, REPRODUCTION, AND PRODUCTION OF ADULT LYMNAEA OBRUSSA SAY (MOLLUSCA: GASTROPODA). Mattice, J. S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 37p. Dep. NTIS $5.00.

From 2nd thermal ecology symposium; Augusta, Georgia, USA (2 Apr 1975).

Shell lengths and egg production were measured weekly under constant (K; 10, 15, 20, 25°C) and varying temperature regimes during the reproductive period. Varying regimes included natural field temperature in a pond (F; diurnal and seasonal), mean daily field temperature (anti F; seasonal) and 5 and 10°C above anti F. Growth rate of large snails (greater than 10 mm) was unaffected by temperature, but small snails (6 to 10 mm) grew fastest at 15°C (K). Growth and reproductive periods were longest, production was highest, and mortality rate was lowest at 15°C (K). Rate (per snail) of egg production increased with temperature. At equal mean temperature, regime affected growth rate only at anti F. Regime affected the following values as shown: mortality rate, F greater than anti F equals K; rate of reproduction, F greater than K greater than anti F; and total production, K greater than anti F equals F. The validity of extrapolation of energetic data from laboratory to field is discussed. Data relating production and temperature are valuable in thermal impact analysis. (auth)

788 (INIS-mf-1648) WATER AND POLLUTION PROBLEMS WITH NUCLEAR POWER PLANTS. Knutzen, J.; Skulberg, O. (Norsk Institutt for Vannforskning, Oslo). 1 Dec 1973. 22p. (In Norwegian). INIS.

Field observations and experimental investigations with species and populations from Oslofjord showed the significance of temperature for important biological parameters, such as primary production, the composition of the plankton populations, and for the maturing and mortality of crustaceans and fish. Measurable effects were found with temperature increases of the magnitude expected from thermal effluents. Investigations carried out in 1973 do not give grounds to change previous (negative) evaluations of the suitability of Oslofjord as a recipient for cooling water discharge from a nuclear power plant. A discharge of 200 m^3/s of heated water would be less doubtful in waters with more clearly defined hydrological conditions. Thermal influences on measures for the purification of the fjord are the subject of introductory discussion. (INIS)

789 (INIS-mf-1649) MEASURES TO REDUCE NEGATIVE RESULTS OF USE OF COOLING WATER. Haugen, I. (Norsk Institutt for Vannforskning, Oslo). 22 Jan 1974. 5p. (In Norwegian). INIS.

It is generally accepted that use of a large amount of cooling water by a nuclear power plant will be detrimental for a recipient. A number of suggestions for minimizing such negative effects, or for exploiting positive effects, are given. These include using a deep intake in the summer months and an intake near the surface in the winter, and the intake of water containing nutrients, which is then discharged in an area with a good supply of oxygen. The possibility of improving the circulation in badly polluted fjords is also suggested. (INIS)

790 (ORNL-tr-2786) INFLUENCE OF HEATING ON THE CONDITION OF PHOTOSYNTHETIC PIGMENTS OF PHYTOPLANKTON IN THE DISCHARGED WATERS OF THE KONAKOVO THERMAL ELECTRIC POWER STATION. Elizarova, V. A. Translated by H. S. Warren from Biol. Vnutr. Vod, Inform. Byull.; No. 17, 13-18(1973). 5p. Dep. NTIS $4.00.

Spectrophotometric methods were used for determining chlorophyll and green and yellow pigments in algal cells exposed to water of power stations at temperatures from 13° to 32°. Results indicated that there were no substantial changes of concentration of chlorophyll or of the condition of the photosynthetic system of the algae during passage across the cooling system of the power plant. (HLW)

791 (PB-227867) REPORT ON WATER QUALITY INVESTIGATIONS OF SNAKE RIVER AND PRINCIPAL TRIBUTARIES FROM WALTERS FERRY TO WEISER, IDAHO. (National Field Investigations Center-Denver, Colo. (USA)). Feb 1973. 131p. NTIS $9.75.

The objectives of the study were to determine the magnitude as well as sources of pollution and to develop water quality control and management programs for the Snake River basin. (GRA)

792 (PB-238311) MODELING AND OPTIMIZATION OF TRANSIENT COOLING WATER DISCHARGE FROM POWER GENERATING PLANTS. Phase II. Applications to Regional Situations. Project Completion Report. Hwang, C. L.; Fan, L. T. (Kansas Water Resources Research Inst., Manhattan (USA)). Aug 1974. Contract DI-14-31-0001-4086. 37p. (CONTRIB-150). NTIS $3.75.

The purpose was to establish a scientifically sound general design procedure that can be used for determining a cooling water discharge policy for a power plant so as not to lead to deterioration of the environmental quality. The research resulted in a series of publications. They contain the results of: water quality modeling and its experimental verification for the Kansas River; optimal configuration of the cooling system for power generation; optimal artificial aeration systems for water quality control of stream receiving thermal and organic waste discharges; optimal basin-wide water quality management under minimum treatment level regulations; and regional water quality management through coordination of urban and agricultural polution control. The summary of significant results of these articles is presented. (GRA)

793 INVESTIGATIONS OF THE THERMAL LOAD CAPACITY OF THE RHINE RIVER. Sauter, H.; Hoffmann, G.; Schikarski, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). KFK Nachr.; 6: No. 3, 6-9(1974). (In German).

The building of the measuring station at Rheinhausen (river-km 394.46 near the nuclear power plant, Philippsburg) for measuring the three main components of the water-atmosphere heat exchange, namely, radiation, evaporation and convection (gradient methods and turbulence-correlation methods) is briefly described. (GE)

794 SEEKING LARGE POWER NUCLEAR SITES IN TERMS OF THE IMPACT OF THERMAL DISCHARGES ON THE ENVIRONMENT. Lebreton, J. C. Trans. Amer. Nucl. Soc.; 20: 426-427(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

795 SOME ENVIRONMENTAL AND SAFETY ASPECTS OF NUCLEAR POWER PLANT WASTE HEAT RELEASE INTO THE ATMOSPHERE. Haschke, D.; Gassmann, F.; Lieber, K.; Trepp, J. P. Trans. Amer. Nucl. Soc.; 20: 440-441(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

796 FISHERY BIOLOGICAL INVESTIGATIONS IN CONNECTION WITH COOLING WATER RELEASE. Field Investigations in the Oslofjord District, January–June 1974. Bratberg, E.; Dahl, E.; Ellingsen, E.; Tveite, S. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen). Fisken Havet; No. 19, 131p (1974). (In Norwegian).

On five expeditions in the Oslofjord district from January to June 1974 the following were investigated: temperature, salinity, oxygen, primary production chlorophyll a, amount and composition of phytoplankton, amount of particles, zooplankton volume, amount and composition of fish eggs and fry, and acoustic fish registration. The phytoplankton studies showed a good correlation between primary production and amount of phytoplankton. The production index indicated that pollution had an inhibiting effect on production in the inner and central parts of the Oslofjord. Little zooplankton was registered, except in June when large amounts were registered in the central and inner Oslofjord. Brisling and mackerel eggs were the dominant fish eggs found. Eggs of cod and plaice were sparsely found and over the whole period few fry were found. The only concentrations of fish which could be registered by echo sounding were found in the Bonnefjord and Frierfjord, and to a lesser degree in Dröbaksundet and Sandebukta. Only limited conclusions can be drawn from a half years investigation due to large natural variations. However, the various potential nuclear power plant site areas show only small variations in biological resources. The outer parts show however lower primary production than the inner parts. (NO)

797 MORTALITY AND GROWTH IN WARMED SEAWATER OF I-GROUP SOLE (SOLEA SOLEA L.) AND HYBRID OF PLAICE (PLEURONECTES PLATESSA L.) AND EUROPEAN FLOUNDER (PLATICHTHYS FLESUS L.). Bratberg, E.; Danielssen, D. D.; Iversen, S. A. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen). Fisken Havet; No. 23, 16p(1974). (In Norwegian).

Experiments were performed with I-group sole and a plaice-European flounder hybrid at the following temperatures: natural temperature at 20 m depth, 12, 15, 18, and 21°C. The object was to investigate the long term effect of high temperatures. The experiments are still in progress. The fish were fed once a day with mussels and oxliver alternately. The experiments began at the same temperature level, and the temperature was increased by about 1°C/day to the desired temperature. During the temperature increase, the sole had a much higher mortality than the hybrids. The mortality of the sole declined, while that of the hybrids increased steadily during the whole period, though not reaching that of the sole. In both series of experiments the mortality was highest among the smallest fish. The sole showed in several cases more significant growth differences between the experiments than did the hybrids. (NO)

798 TEMPERATURE PREFERENCE IN COD (GADUS MORHUA L.). Bratberg, E.; Boehle, B. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen). Fisken Havet; No. 20, 28p (1974). (In Norwegian).

The object of the experiments was to determine in which temperature range cod preferred to reside and which temperatures they could accept for short periods. The experiment aquarium consisted of two sections connected by a tunnel, with heater elements, resistance thermometers, and oxygenators in both sections. A cooler was connected to both sections and the water continuously cooled. Ultrasonic detectors in the tunnel registered the fish passing, and the direction of passage. The temperatures in the two sections and the fishes movements were recorded on charts. The results were not entirely consistent, but the fish accepted up to 16 to 17°C before an evading reaction occurred. In some cases they seemed to accept up to 18 to 19°C. The lowest acceptable temperature was not clearly determined in this experiment. In the cooling water recipient of a nuclear power plant a temperature gradient will exist in which the temperatures will vary seasonally. The results presented indicate that cod normally will accept, and possibly prefer, relatively high temperatures. It is assumed that only at certain seasons will the water temperature be so high that the cod will leave, and the area they avoid will be small. (NO)

799 THERMOPOLLUTION IN THE AQUATIC ENVIRONMENT. Bourodimos, E. L. (Rutgers–The State Univ., New Brunswick, NJ). pp 183-209 of Against Pollution and Hunger. Notes Toward a New World. Hilton, M. A. (ed.). Oslo; Universitetsforlaget (1974).

From conference of the Society for Social Responsibility in Science; Trondheim, Norway (26 Aug 1971).

Following introductory remarks on pollution and environmental problems in general, the balance of an aquatic ecosystem is discussed. The importance of dissolved-oxygen (DO) is emphasized and the theory of the dissolved-oxygen sag is presented and illustrated in curves, including the effect of temperature on the reaeration coefficient. The mechanisms of heat transfer and dissipation across the surface are also discussed. Some remarks on the biology of aquatic communities and their ecological interactions with heat disposal are made. In considering techniques for the abatement of thermal pollution the hydrodynamic aspects of submerged heated effluents and mixing from free jets are first discussed. The interplay of turbulent convection and dispersion, molecular diffusion, gravitational convection, and circulation due to density gradients is discussed in general terms. Cooling ponds and cooling towers are briefly discussed. Possible beneficial uses of waste heat in aquaculture are mentioned. In the concluding section the problems of thermal pollution are related to the policies in future power generation with particular reference to USA. (NO)

800 BEFORE AND AFTER STUDIES ON THE EFFECTS OF A POWER PLANT INSTALLATION ON LAKE LYNDON B. JOHNSON. Evaluation of 1971 and 1972 Data. Austin, TX; University of Texas (1974). vp.

The overall goal of this project is to determine if the proposed LCRA power plant operations have any significant effect, beneficial or detrimental, on the Lake LBJ ecosystem. One of the purposes of this study during 1971 and 1972 was to evaluate the data obtained. Another objective was to determine if the sampling program designed in January 1971 was adequate if the sampling stations or field collection procedures or measurements should be changed in 1973, the last year before the power plant begins operation. The third purpose was to develop mathematical models to simulate the natural annual thermal cycle of Lake LBJ and to estimate the variation of temperature in the reservoir cove receiving the power plant discharge. The trends in the 1971 and 1972 data indicate that Lake LBJ is essentially functioning as a "new" reservoir subsequent to reservoir lowering and refilling in late 1970 and early 1971. Water quality and biological populations are expected to continue this trend through 1973 and possibly during the first years of power plant operations. Hence it appears unlikely that "before" data obtained at a specific sampling station can be compared directly to "after" data obtained at the same station to estimate the effect of power plant operations. However, the water quality and biological populations throughout the reservoir are not statistically different; hence the power plant effects, if any, probably can be estimated from a comparison of the intake and discharge coves with "control" coves. The reservoir's rooted vegetation is practically extinct due to the drying of the sediments during the period in which the reservoir was lowered. However no apparent significant detrimental effect subsequently occurred to the Lake LBJ ecosystem. "Sports" fish netting, applying rotenone for "rough" fish elimination and subsequent restocking of fingerling "sports" fish apparently did not hinder reestablishment of the "rough" fish populations. Fish sampling stations are required in the intake and discharge coves to assess the effect of the power plant. A one-dimensional thermal stratification model was applied satisfactorily to Lake LBJ, a reservoir with a high discharge-to-volume ratio. A two-dimensional temperature stratification model was developed to estimate the effect of the power plant effluent on the energy balance and stratification behavior of the discharge bay. (auth)

801 MORTALITY OF PRAWNS (PANDALUS BOREALIS KROEYER) AND COD (GADUS MORHUA L.) IN WARMED SEAWATER. Bratberg, E.; Boehle, B. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen). Fisken Havet; No. 21, 27p (1974). (In Norwegian).

The experiments show that deep water prawns can survive a temperature of 15 to 15.5°C for a 10-day period. When accustomed to 9°C, compared with normal 5.8°C, they could survive a 1°C higher temperature. It is assumed that the prawns would become accustomed to a higher temperature resulting from thermal discharge from a nuclear power plant. It is concluded that the mortality at 12 to 14°C due to the temperature will be so small as to be indistinguishable from natural mortality. The experiments also show that small cod can survive relatively high temperatures, 19.5 to 20.0°C for a 10-day period. The acute mortality seems to occur mainly in the first day. After becoming accustomed to about 16°C it took longer before the fish died, and they survived 20.5 to 21.0°C. In experiments where cod in better condition were used none died at a temperature lower than 19°C. Since fish can swim away it is improbable that they will die as an immediate result of a too high temperature. (NO)

802 DIVERSITY OF MARINE INVERTEBRATES IN A THERMAL EFFLUENT. Logan, D. T.; Maurer, D. (Univ. of Delaware, Lewes). J. Water Pollut. Contr. Fed.; 47: No. 3, 515-523(Mar 1975).

Invertebrates were collected at four sites in the Indian River and Indian River Bay in Delaware to study the effects of thermal effluents from a steam-generating plant. A list of species of anemones, nemerteans, annelids, molluscs, and crustaceans is presented. Differences in species composition, an increase in relative numbers of a pollution indicator organism, and reduction in species number and in the total number of organisms in the effluent were noted. The period of highest diversity corresponded to that of the lowest numbers of species and individuals and highest effluent temperatures. (HLW)

Chemical Effluents

Refer also to abstracts 761, 767, and 986.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 338, 626, 630, 986, 1037, 1618, 2217, 2414, 2425, 2427, and 2686.

803 (AED-CONF-74-509-039) NEUTRON MEASUREMENT BY MEANS OF A HELIUM-3 COUNTER WITH SPHERICAL MODERATOR. Mourgues, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). 1974. 8p. (In French). INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

A new helium-3 counter for the measurement of neutron fluence is described with the following characteristic features: better sensitivity and time stability compared to formerly used iodine and lithium crystal counters, and a higher insensitivity to background gamma rays. (GE)

804 (BNL-19789) NEUTRON CAPTURE CROSS SECTION MEASUREMENT TECHNIQUES. Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 10p. (CONF-750303-53). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A review of currently-used techniques to measure neutron capture cross sections is presented. Measurements involving use of total absorption and Moxon-Rae detectors are based on low-resolution detection of the prompt gamma-ray cascades following neutron captures. In certain energy ranges activation methods are convenient and useful. High resolution gamma-ray measurements with germanium detectors can give information on the parameters of resonance capture states. The use of these techniques is described. (auth)

805 (GSCan-P-73-28) IONIZATION CHAMBER FOR CONTINUOUS MONITORING OF ATMOSPHERIC RADON: RADON-222 LEVELS IN OTTAWA AND GATINEAU HILLS, CANADA. Dyck, W. (Geological Survey of Canada, Ottawa, Ontario). 1973. 11p. INIS.

A 250-liter ionization chamber was constructed and tested and was found to be suitable for continuous monitoring of atmospheric radon. The ionization chamber consists essentially of a shielded 45 cm I.D. × 150 cm stainless steel cylinder, a 2 cm center electrode and a filter and blower at the inlet. The negative ion current generated by ionizing radiation is collected from the center electrode by a vibrating capacitor-type electrometer. To cancel the relatively large but constant background due to gamma-rays and junction potentials, only the fraction of the signal above this background level is amplified, smoothed and recorded on a chart recorder. When stationary the chamber has a radon-222 sensitivity of 0.0045 pc/1/mpA and a detection limit of about 0.04 pc/1 when the signal is integrated hourly. Continuous monitoring of atmospheric air from an elevation of 85 feet above ground level at the Geological Survey of Canada Building, Ottawa, revealed a diurnal cycle in the radon-222 content on quiet days with a maximum in the early morning hours. In general, higher radon levels corresponded with hazy quiet atmospheres and lower levels with clear and windy or rainy days. Several tests in the Gatineau Hills, Quebec, showed that air from a 30-foot height contained about the same amount of radon at Fortune Lake where uranium mineralization is known to occur as at Pinks Lake where no uranium mineralization is evident. By placing the chamber in a boat on a lake and passing compressed air, which had been used to agitate the water, through the chamber a reading much stronger than that from atmospheric air was obtained. Suitably modified, the ionization chamber could become useful in the search for uranium mineralization covered by water. (auth)

806 (INT-67/J) APPLICATION OF THE FINITE-DIFFERENCE APPROXIMATION TO ELECTROSTATIC PROBLEMS IN GASEOUS PROPORTIONAL COUNTERS. Waligorski, M. P. R. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1975. 43p. Dep. NTIS (US Sales Only) $5.25.

The basic principles of the finite-difference approximation applied to the solution of electrostatic field distributions in gaseous proportional counters are given with the aim of making this method more popular with authors dealing with electrostatic problems. Using this method, complicated two-dimensional electrostatic problems may be solved, taking into account any number of anodes, each with its own radius, and any cathode shape. A general formula for introducing the anode radii into the calculations is derived and a method of obtaining extremely accurate (up to 0.1%) solutions developed. Several examples of potential and absolute field distributions for single rectangular and multiwire proportional counters are calculated and compared with exact results according to Tomitani, in order to discuss in detail, errors of the finite-difference approximation. (auth)

807 ELECTRON-PROTON SPECTROMETER FOR THE GEOS SATELLITE. Gunzenhauser, R. Dornier-Post (Engl. Ed.); No. 4, 18-21(1972).

The S 321 electron-proton spectrometer is used in one of the nine experiments which are to be conducted with the aid of the GEOS geostationary satellite. The satellite is to be launched by the European Space Research Organization in 1976. The experiments are to provide information regarding the distribution of electrical and magnetic fields and waves, the thermal plasma, and energy particles. The S 321 experiment, in particular, is conducted to study the behavior of particle flows and energy spectra of protons and electrons. The main components of the spectrometer are discussed. (IAA)

808 TWENTY FIVE YEARS OF SCINTILLATION COUNTING. Hofstadter, R. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 13-25(Feb 1975).

From 21st nuclear science symposium; 14. scintillation and semiconductor counter symposium; 6. nuclear power systems symposium; Washington, DC (11 Dec 1974).

A historical review of the development and uses of scintillation counters is given. (WHK)

809 SCINTILLATION COUNTER STORY. Part II. Morton, G. A. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 26-28(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A review of the historical evolution of the photomultiplier for scintillation counting is presented. (WHK)

810 SCINTILLATION COUNTER STORY. Part III. Morton, G. A. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 29-30(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A short historical review of the development of electronic circuits for use with scintillation counters is presented. (WHK)

811 ENERGY TRANSFER IN ALKALI HALIDE SCINTILLATORS BY ELECTRON-HOLE DIFFUSION AND CAPTURE. Murray, R. B. (Univ. of Delaware, Newark). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 54-57(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Recent calculations and experiments dealing with charge transport and capture in activated alkali halide scintillators are reviewed. Both electrons and holes are captured at thallium sites in crystals such as KI(Tl) and NaI(Tl). The kinetics of charge transport is governed either by the diffusive motion of the self-trapped hole, or by the release of electrons from a thallium site. (auth)

812 BASIC LIMITATION OF SCINTILLATION COUNTERS IN TIME MEASUREMENTS. Lynch, F. J. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 58-64(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The time resolution of a scintillation detector can be calculated from the scintillator illumination function, and the response of the photomultiplier to an instantaneous pulse of light. Such calculations using the parameters of present scintillators and photomultipliers agree with measured resolutions and predict improvements which can be achieved. Parameters of commercial and some promising experimental fast scintillators are given, as well as measurements on transit time spread of some fast photomultipliers. (auth)

813 BISMUTH GERMANATE: A HIGH-Z GAMMA-RAY AND CHARGED PARTICLE DETECTOR. Nestor, O. H.; Huang, C. Y. (Harshaw Chemical Co., Solon, OH). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 68-71(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The room-temperature scintillation characteristics of single

crystals of $Bi_4Ge_3O_{12}$ under gamma-ray and alpha-particle excitation have been determined. The wavelength of maximum intensity in the scintillation spectrum is 480 nm. A decay constant of 0.30 microseconds was measured. Scintillation efficiency (pulse height) varied linearly with gamma-ray energy, E, and the resolution varied as E/sup -1/2/. 8 percent pulse height relative to NaI(Tl) with 15 percent resolution was measured for a 2.2 cm x 1.7 cm crystal under excitation by Cs^{137} 0.662 MeV gamma-rays. (auth)

814 TIN AND LEAD LOADED PLASTIC SCINTILLATORS FOR LOW ENERGY GAMMA-RAY DETECTION WITH PARTICULAR APPLICATION TO HIGH RATE DETECTION. Cho, Z. H. (Univ of California, Los Angeles); Tsai, C. M.; Eriksson, L. A. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 72-80(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

It has been observed that loading plastic scintillators with tin or lead markedly increase their low energy photon detection efficiencies while retaining the characteristic short phosphor decay time of conventional plastic scintillators. These combined effects may have great impact in high rate photon detection; for instance, x-ray transmission 3-D image reconstruction applications in the biomedical field and Moessbauer experiments in nuclear structure studies. Experimental data are reported on (a) photon detection efficiencies using a 5 percent tin loaded, a 7 percent tin loaded and a 5 percent lead loaded plastic scintillator with reference to a NaI(Tl) crystal in the energy range of 20 to 511 keV; (b) high count rate detection up to 20 MHz with ^{153}Gd (42 + 100 keV groups); and (c) Moessbauer experiments with thin discs of tin loaded plastic scintillators. (auth)

815 SCINTILLATION RESPONSE OF A SINGLE LITHIUM FLUORIDE CRYSTAL. Kloepping, R. J. (Lawrence Livermore Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 81-84(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Lithium fluoride (activated) crystals were prepared by the Bridgeman–Stockbarger and Czochralski methods. Measurements have been made on the scintillation response of a LiF crystal to photon energies between 8 and 1333 keV. The tissue dose in rads was calculated and compared to the response of the LiF crystal over the same energy range. The response of a single titanium-activated LiF crystal was compared to the response of a NE 109 air-equivalent scintillator at ^{60}Co energies. The absorption and emission spectra of the LiF crystal were obtained. (auth)

816 ENTOPISTIC SCINTILLATORS. Arens, J. F. (Goddard Space Flight Center, Greenbelt, MD); Maehl, R. C.; Rogers, E. H. Jr.; Whiteside, H.; Schmidt, W.; Simon, M. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 85-87(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Trajectories of cosmic rays through a Goddard Space Flight Center–Max Planck Institute balloon-borne experiment will be determined by pulse height analyzing the signals from each of the two or more phototubes coupled to each scintillator. Thin or tapered scintillators produce sufficiently strong gradients of phototube signal with respect to scintillation position that position uncertainties of approximately 1 cm can be achieved over approximately 1 m^2 areas. Calculations and some tests results for entopistic, or position determining, scintillators are presented. (auth)

817 FABRICATION AND X-RAY CALIBRATION OF THIN PLASTIC SCINTILLATOR DETECTORS. Lyons, P. B.; Lier, D. W. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl Sci.; NS-22: No. 1, 88-92(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Thin film plastic scintillator detectors were fabricated and calibrated with x rays in the 1.5 to 20 keV range. The calibration systems used are described. Measurements showed that the presence of a film substrate can significantly change the detector response. X-ray conversion efficiency was determined as a function of energy and shown to be a strong function of energy for low energy x rays. (auth)

818 RESPONSE OF CsI(Tl) TO ENERGY DEGRADED FISSION FRAGMENTS. Fellas, C. N. (Univ. of Surrey, Guildford, Eng.); Gilboy, W. B.; Ginger, D. A. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 93-95(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The scintillation response of a CsI(Tl) crystal to energy degraded fission fragments derived from a ^{252}Cf spontaneous fission source has been measured over the energy ranges 34 to 51 MeV (heavy fragment) and 42 to 74 MeV (light fragment). The response to gamma-ray induced electrons and to alpha-particles was also measured for comparison purposes. The results indicate that the scintillation response for these particles is a monotonically decreasing function of specific energy loss. (auth)

819 CHORD LENGTH DISTRIBUTION IN CYLINDRICAL DETECTORS IN ISOTROPIC AND NONISOTROPIC RADIATION FIELDS. Hajnal, F.; Klusek, C. (Atomic Energy Commission, New York). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 96-99(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

To evaluate cosmic-ray measurements, the chord length distributions for various elongations of cylindrical scintillation detectors were determined for isotropic and nonisotropic (J equals J_0 cos gamma theta) radiation fields by Monte Carlo techniques. The mean chord lengths obtained from the calculations are in excellent agreement with those obtained from Cauchy's theory. (auth)

820 RECENT ADVANCES IN GAS SCINTILLATION PROPORTIONAL COUNTERS. Palmer, H. E. (Pacific Northwest Lab., Richland, WA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 100-103(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Various geometrical configurations for gas scintillation proportional counters have been investigated in order to determine which is best for use in a large volume, high efficiency counter for measuring low energy gamma and x-rays. A xenon filled counter having a rod anode inside a cylindrical cathode appears to provide the best configuration for providing a uniform field and the best resolution over the total volume of the counter. The details of construction and operating characteristics of various shaped counters are described. (auth)

821 ARGON GAS SCINTILLATION COUNTER WITH UNIFORM ELECTRIC FIELD. Conde, C. A. N.; Santos, M. C. M.; Ferreira, M. F. A.; Sousa, C. A. (Univ., Coimbra). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 104-108(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A new type of gas proportional scintillation counter with uniform electric field is described. This counter is the scintillation counter analog of the Frish ionization chamber. Its principle is discussed and the properties experimentally studied using pure argon. Energy resolutions of 1.9 percent were obtained for 8.1 MeV alpha particles. Some results concerning the interpretation of the mechanism of the secondary scintillation are discussed. (auth)

822 ENERGY RESOLUTION AND WINDOW AREA CAPABILITIES OF THE GAS PROPORTIONAL SCINTILLATION COUNTER. Alice, M.; Alves, F.; Policarpo, A. J. P. L.; Leite, M. S. S. C. P. (Univ., Coimbra). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 109-115(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The behavior of xenon and argon-xenon gas proportional scintillation counters is considered. For x-rays, ranges of window area are defined showing competition with semiconductor detectors. Data for primary scintillation of x-rays and alpha particles are included. Relative efficiencies of tetraphenylbutadiene, p-terphenyl, diphenyl-stilbene, sodium salicylate and p-quaterphenyl were measured. (auth)

823 QUANTUM EFFICIENCY MEASUREMENTS OF WINDOWLESS ELECTRON MULTIPLIERS TO HEAVY HIGH ENERGY PARTICLES. Cho, Z. H.; Singh, M.; Mohabbatizadeh, A. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 121-126(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Measurements of quantum efficiency to heavy charged particles, in particular to the proton, in the range of 0.5 to 2 MeV were made with windowless electron multipliers on cathodes of beryllium oxide and aluminum oxide. The effects of oxide thickness on

quantum efficiency were determined and some qualitative explanations have been made based on the simple ionization process and escape probability of produced electrons. Using a Van de Graaff accelerator at beam currents of 0.1 nA to 0.5 nA, precisions of measurement of better than 10 percent were obtainable with six different cathodes: three different thicknesses of BeO and three of Al_2O_3 respectively. (auth)

824 DEAD LAYERS AT THE SURFACE OF p-i-n DETECTORS: A REVIEW. Dinger, R. J. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 135-139(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A review of recent work concerning dead layers at the surface of p-i-n detectors is given. Surface states, produced during preparation of the detector or by adsorbed gases at its surface, often lead to a surface channel. In the high-resistivity active volume of the detectors the thickness of the surface channel can be as much as 1 mm. The charge collection within a surface channel is disturbed and it is shown, by theory and experiment, that this results in the dead layers frequently observed on p-i-n detectors. (auth)

825 PROPERTIES OF METAL SURFACE BARRIERS ON HIGH PURITY GERMANIUM. Malm, H. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 140-144(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Measurements of the Schottky barrier heights formed by evaporating various metals onto etched slices of n type Ge show that the barrier height and the reverse leakage current depend on the metal work function. The results are consistent with a surface state density on the Ge greater than or equal to $5 \times 10^{13}/cm^2$. eV. Only metals with work functions greater than 4.4 eV give acceptably small reverse currents at 80^0K. Of these, evaporated Ni or Pd are judged to be best for spectrometers. (auth)

826 COMPARATIVE IONIZATION ENERGIES FOR PROTONS, DEUTERONS, AND ALPHA PARTICLES IN HIGH PURITY GERMANIUM AND Si(Li) NUCLEAR RADIATION DETECTORS. Martini, M.; Raudorf, T. W.; Stott, W. R.; Waddington, J. C. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 145-148(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Relative measurements of the average energy, epsilon, expended for electron-hole pair generation in silicon and high purity germanium detectors were made using 10 to 19 MeV proton, deuteron and alpha particle beams. The results show that epsilon is constant for different particles in high purity germanium detectors but not in silicon detectors. A model is presented which could explain both our results and those published in the literature. (auth)

827 FAST NEUTRON RADIATION DAMAGE OF HIGH-PURITY GERMANIUM DETECTORS. Kraner, H. W. (Brookhaven National Lab., Upton, NY); Pehl, R. H.; Haller, E. E. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 149-159(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Seven high resolution, high-purity planar germanium and two lithium-drifted germanium detectors have been exposed to fluences of monoenergetic fast neutrons of 1.4, 5.5 and 16.4 MeV to study radiation damage effects. Seven of the exposures were made at 5.5 MeV using detectors made from both LBL and General Electric Company material. Initial degradation of ^{60}Co energy resolution was generally observed after fluences of 3×10^{9} n/cm^2. After fluences of 10^{10} n/cm^2, the detector resolutions were all affected, and replacement would be required in most gamma ray spectrometry; these results are consistent with previous damage studies on germanium detectors. Considerable variability in neutron damage threshold between detectors was observed within this fluence range which must be attributable to a material parameter that is not yet fully determined. (auth)

828 PREPARATION AND CHARACTERISTICS OF NATURAL DIAMOND NUCLEAR RADIATION DETECTORS. Kozlov, S. F. (Lebedev Inst. of Physics, Moscow); Stuck, R.; Hage-Ali, M.; Siffert, P. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 160-170(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

It is shown that natural diamond can be used as a homogeneous conduction counter with near complete charge collection, even over a long period of time. Indeed, polarization effects have been suppressed by making the back contact of the detector injecting under the influence of the applied field in order to compensate for trapped charge carriers. The electric and detection characteristics of these counters have been investigated. Possible application fields are briefly discussed. (auth)

829 DETAILED INVESTIGATIONS ON ABNORMAL PULSE SHAPES IN Ge(Li) DETECTORS. Bruening, N.; Fretwurst, E.; Lindstroem, G. (Univ., Hamburg). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 173-176(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The detailed pulse form for pulses with abnormally long rise times have been measured in two different Ge(Li) detectors. Most of these pulses show distinctive differences from normal pulse shapes. These deviations can be explained by the existence of local zones with highly reduced electric field strength, which lead to long drift times and an increased trapping probability. The observed correlation between abnormal pulse shapes and nonideal charge collection is discussed. (auth)

830 LITHIUM-DIFFUSED n^+ CONTACTS ON HIGH-PURITY GERMANIUM DECTECTORS: HOW THIN CAN THEY BE MADE; HOW STABLE ARE THEY. Pehl, R. H.; Cordi, R. C. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 177 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A Li-diffused n^+ surface layer is the best n^+ contact developed up to the present time. However, the effective dead layer resulting from the Li-diffusion prevents the optimum stacking of detectors for counter telescopes. Diffusion temperatures as low as 160^0C have been successfully used to produce effective dead layers as thin as 10 mu. Unfortunately, these dead layers increase significantly when the detector is annealed following radiation damage. (auth)

831 CHARGE CARRIER TRANSPORT PROPERTIES OF SEMICONDUCTOR MATERIALS SUITABLE FOR NUCLEAR RADIATION DETECTORS. Ottaviani, G.; Canali, C.; Quaranta, A. A. (Univ., Modena, Italy). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 192-204 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Charge carrier drift velocities in semiconductor materials suitable for solid state detectors have been reviewed. Si, Ge, CdTe and GaAs are considered. New data for HgI_2 recently obtained are also reported. The data cover a large range of temperatures (6 to 430^0 K) and electric fields up to 50 kV/cm. An anisotropy effect in the drift velocity obtained by applying the electric field parallel to different crystallographic axes is also discussed for the case of Si and Ge. (auth)

832 OPTICAL QUENCHING IN CdTe DETECTORS. Martin, G.; Bach, P.; Tranchart, J. C.; Fabre, E. (Laboratories d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 226-228(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The intrinsic resolution of low energy photopeaks with CdTe detectors is shown to be improved if the detectors are illuminated with a GaAs electroluminescent diode. Time of flight measurements on this CdTe material exhibit a strong modification of the current response under a given monochromatic infra-red illumination. The interpretation involves trapping effect and its optical quenching. (auth)

833 CHARACTERIZATION EFFORT OF HgI_2 RADIATION DETECTORS BY PULSED LASER TRANSIENT CHARGE INJECTION TECHNIQUE. Cho, Z. H. (Univ. of California, Los Angeles); Watt, M. K.; Slapa, M.; Tove, P. A.; Schieber, M.; Davies, T.; Schnepple, W.; Randtke, P. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 229-240(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Both space-charge-limited current and space-charge-free current pulses for electron and hole injection in HgI_2 crystals have been observed using the Pulsed Laser Transient Charge Technique. A semi-quantitative theoretical analysis is made

based on the assumption of a semi-insulating material. The current pulse analysis includes trapping, detrapping, field dependent trapping times (in both space charge free and limited cases), and plasma dispersal times. Measurement of trapping times and mobilities for both types of carriers are made from the pulse shapes. Measured values for the mobilities of both electrons and holes and trapping times are comparable to previous measurements using different techniques. The experimental techniques are also described. Lastly, the crystal growing techniques are outlined. (auth)

834 STUDY OF THE BEHAVIOR OF TRAPS IN CdTe NUCLEAR DETECTORS BY OPTICAL TECHNIQUES. Bell, R. O. (Tyco Lab., Inc., Waltham, MA); Wald, F. V.; Goldner, R. B. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 241-245(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A method involving the generation of charge carriers by nuclear particles (alpha-particles or gamma-rays) and measuring the charge collection efficiency or counting rate while simultaneously exciting with monochromatic light has been used for the study of deep traps in CdTe intended for semiconductor detectors. The electric field distribution may be determined by looking at the shape of the pulse. A way of directly observing the electric field was to utilize the electro-optic effect of CdTe, which has the zincblende structure, by viewing the optical transmission between crossed polarizers as a function of applied bias and time. These techniques have been applied to CdTe but can be applied to other materials. (auth)

835 Bi_2S_3 AS A HIGH Z MATERIAL FOR gamma-RAY DETECTORS. Wald, F. V.; Bullitt, J.; Bell, R. O. (Tyco Labs., Inc., Waltham, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 246-250(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The semiconductor Bi_2S_3 has a bandgap of 1.3 eV and reported mobilities of 200 cm^2/V for holes and 1100 cm^2/V for electrons. Its absorption cross section is 1.8 times that of $Hg I_2$. Compensation of this material to 10^7 to 10^9 OMEGA-cm and initial results on gamma-ray detection properties are reported. (auth)

836 TWO-DIMENSIONAL POSITION-SENSITIVE DETECTOR FOR THERMAL NEUTRONS. Alberi, J.; Fischer, J.; Radeka, V.; Rogers, L. C.; Schoenborn, B. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 255-268 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

We have developed and tested a thermal neutron, two-dimensional position-sensitive detector for use in neutron scattering from biological samples. The detector is based on a multi-wire proportional concept with a gas filling of 6 atmos. ^3He, 4 atmos. A, and 0.5 atmos. CO_2. The position readout uses a resistive wire with charge division to determine position. We have measured a resolution of less than 3 mm (FWHM) with a detection efficiency of 70 percent at 2.8 A neutrons. Considerations leading to an optimal configuration are discussed. (auth)

837 SPHERICAL DRIFT CHAMBER FOR X-RAY IMAGING APPLICATIONS. Charpak, G.; Hajduk, Z.; Jeavons, A.; Kahn, R.; Stubbs, R. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 269-271(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Properties of proportional chambers with spherical drift spaces have been investigated. An experiment of x-ray diffraction in crystals shows that an accuracy of 0.5 mm, at 20^0 inclination with respect to the axis of the chamber, can be obtained with 4 cm of drift length. Such chambers have many applications: X-ray diffraction patterns, pin-hole imaging, angular distributions of cascades of x-rays in nuclear physics, etc. (auth)

838 APPLICATION OF LARGE AREA ORGANIC QUENCHED GEIGER COUNTERS TO RADIATION MONITORING. Jones, A. R.; (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-22: NS-22: No. 1, 277-281(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Because one can operate organic quenched counters near atmospheric pressure, they can be built with large area (250 cm^2), thin (7 mg/cm^2) windows to monitor large areas of low energy beta activity. To avoid the problem of short life (approximately 10^8 counts) they are only biassed during a shortened monitoring period and are shielded against background radiation. (auth)

839 CARBON DIOXIDE QUENCH ACTION IN A BERYLLIUM PROPORTIONAL COUNTER. Bawdekar, V. S. (American Science and Engineering, Inc., Cambridge, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 282-285(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Chemical reactions at the cathode in a beryllium proportional counter with CO_2 quench gas are analyzed. It is shown that the CO_2 will be dissociated at the cathode. It is further shown that the counter will be contaminated with carbon as the CO produced as a result of the CO_2 dissociation is in turn dissociated at the cathode. The dissociation of CO_2 quench gas is offered as a plausible hypothesis for the carbon contamination and the accompanying instability often encountered in such a counter towards the end of its life. (auth)

840 EFFECT OF IMPROVING ENERGY RESOLUTION ON GAMMA CAMERA PERFORMANCE: A QUANTITATIVE ANALYSIS. Llacer, J. (Univ. of California, Berkeley); Graham, L. S. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 309-330(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Modulation Transfer Functions (MTF) of two commerical cameras and of a single element germanium camera fitted with different collimator configurations have been studied theoretically and experimentally in order to separate the different elements which contribute to the imaging capabilities of a gamma camera. Effects due to size and shape of collimator holes, and to positron range at 511 keV, have been treated as filtering functions, predicting the behavior of a camera quite accurately. The effect of energy resolution has then been studied by noting the changes in MTF and the corresponding changes in the computer generated image of a low contrast circularly symmetric phantom as a function of energy resolution. The possibility of excellent imaging under low contrast situations with high-energy resolution detectors is demonstrated, and the required penalty in camera speed is documented. (auth)

841 IMAGING EFFICIENCY OF Ge AND NaI(Tl) GAMMA-RAY DETECTORS. Strauss, M. G.; Sherman, I. S. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 331-343(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A figure of merit is derived for the efficiency with which a detector images a gamma-ray emitting object using the signal-to-noise ratio as the criterion. Photons scattered in the detector that ultimately culminate in photoelectric absorption produce an undesirable background when imaging with position-sensitive detectors as in cameras. When imaging with detectors that are not position sensitive as scanners, these photons contribute to the image of the object. In comparison with NaI(Tl), Ge detectors have lower photoelectric efficiency and higher detector scatter. However, these are offset by much higher energy resolution and the consequent near complete tissue-scatter rejection. As a result, the imaging efficiency for a brain phantom at 150 keV is shown to be comparable for Ge and NaI(Tl) cameras. In the case of scanners, the imaging efficiency of Ge was calculated to be 40 to 75 percent higher for a brain phantom with a one gamma-ray emitting radionuclide such as ^{99}/sup m/Tc, and effectively 2 to 2.5 times higher for a three gamma-ray emitting radionuclide such as ^{67}Ga. The imaging efficiency, which depends on absorption characteristics and energy resolution, is a measure of the total performance of the detector. It is shown that in addition to being useful for comparing different types of detectors, this figure of merit also provides means for optimizing imaging parameters such as detector thickness. (auth)

842 COMPARATIVE STUDY OF 3-D IMAGE RECONSTRUCTION ALGORITHMS WITH REFERENCE TO NUMBER OF PROJECTIONS AND NOISE FILTERING. Cho, Z. H. (Univ. of California, Los Angeles); Chan, J. K.; Hall, E. L.; Kruger, R. P.; McCaughey, D. G. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 344-358(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A comparative study of four popular 3-D image reconstruction algorithms has been made. Particular attention was given to

artifacts generated and noise sensitivity. The methods considered include two spatial domain convolution algorithms, the Linear Superposition with Compensation (LSC) and a Fourier Convolution Method (FCM), a direct Fast Fourier Transform method (FFT), and an algebraic technique, the Simultaneous Iterative Reconstruction Technique (SIRT). The methods were compared by computing reconstructed images for an identical input phantom image. The phantom image contains several edges and a 2 percent contrast object. Variations, artifacts and noise sensitivity are easily visualized by perspective plots of the reconstructed images. Considerations as to the optimum algorithm for a particular application are discussed. (auth)

843 TOMOGRAPHIC RECONSTRUCTION FROM FAN BEAM GEOMETRY USING RADON'S INTEGRATION METHOD. Beattie, J. W. (Memorial Sloan-Kettering Cancer Center, New York). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 359-363(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Tomographic scanners of the parallel beam and fan beam type have differences in the direction of sweep, r vs. phi respectively. This leads to different options in the "fill" of the sampling space, which may be important in accurate reconstruction. These differences are denoted in reference to the Radon integrational method of reconstruction. An algorithm using source angle gating of data from a fan beam scanner is given with a reconstruction from a simulation phantom scan which used discrete source and detector apertures with rotation smearing. (auth)

844 POTENTIAL PERFORMANCE OF OFF-AXIS FRESNEL ZONE PLATE GAMMA IMAGING SYSTEMS ON ARBITRARY OBJECTS. Joy, M. L. G.; Houle, S. (Univ. of Toronto). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 364-368(Feb 1975).

Fron 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The coded aperture method of imaging gamma rays in nuclear medicine has two major potential advantages over the more conventional parallel hole or pinhole imaging methods. A coded aperture system can, under certain conditions, produce images with less quantum noise than is produced by conventional systems under similar conditions. It can also be focused on planes in the object after the image has been recorded. The former attribute is discussed, and those conditions which permit quantum noise suppression are shown. This discussion is based on a comparison of Fresnel off-axis zone plate systems with conventional pinhole systems. The effects of quantum noise are measured by the standard deviation of the images produced. Camera designs are optimized with respect to this criterion and under identical physical constraints. (auth)

845 SMALL SIGNAL SUPPRESSION IN CODED APERTURE IMAGING IN NUCLEAR MEDICINE. Houle, S.; Joy, M.L.G. (Univ. of Toronto). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 369-373(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The suppression of small signal information by the quantum noise in an off axis Fresnel zone plate coded aperture system is described. This effect, directly related to the dc gain of the aperture and to the spatial variation of the variance in the decoded image, more than outweighs the geometric efficiency and thereby limits the widespread use of this new technique in nuclear medicine. (auth)

846 CODED APERTURE IMAGING OF GAMMA-RAYS USING MULTIPLE PINHOLE ARRAYS AND MULTIWIRE PROPORTIONAL CHAMBER DETECTOR. Chang, L. T.; Macdonald, B.; Perez-Mendez, V.; Shiraishi, L. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 374-378(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Coded shadows of gamma-ray distributions have been made using both random pinhole and non-redundant pinhole coded apertures with a multiwire proportional chamber as detector. Image reconstruction is done optically with incoherent light. Lateral and depth resolution results are presented and calculations of background and signal to noise ratios for the non-redundant aperture are made and compared with the single pinhole collimator. (auth)

847 BEST LINEAR DECODING OF RANDOM MASK IMAGES. Woods, J. W.; Ekstrom, M. P.; Palmieri, T. M.; Twogood, R. E. (Lawrence Livermore Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 379-383(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

In 1968 Dicke proposed coded imaging of x and gamma rays via random pinholes. Since then, many authors have agreed with him that this technique can offer significant image improvement. A best linear decoding of the coded image is presented, and its superiority over the conventional matched filter decoding is shown. Experimental results in the visible light region are presented. (auth)

848 MULTICHANNEL MINIATURE SEMICONDUCTOR DETECTOR SYSTEM WITH ON-LINE COMPUTER ANALYSIS FOR MEASUREMENT OF MINIREGIONAL CEREBRAL BLOOD FLOW. Yamamoto, Y. L.; Meyer, E.; Feindel, W. (McGill Univ., Montreal). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 384-387(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

This paper outlines experience over the past decade with a multichannel miniature semiconductor detector system for measurement of miniregional cerebral blood flow. 8 channels of a lithium drifted silicon detector system with on-line computer analysis are satisfactorily operating in monitoring quantitative regional cerebral blood flow on multisites of the brain in vivo in humans as well as animals. More recently, our experience with a highly gamma sensitive cadmium telluride detector (CdTe) was disappointing. For ^{133}Xe clearance studies, the CdTe detector gave a 5 times higher counting efficiency than the Si(Li) detector. However, blood flow values obtained by stochastic analysis from the CdTe detector are 25 to 40 percent less than the values obtained from the Si(Li) detector. This problem appears to be mainly due to a trapping phenomenon occurring in the CdTe detector which gives a nonlinear response between radioactivity and count rate, and over exceeds random fluctuation of count rate. These genetic and temperamental features of the CdTe detector make it unsuitable for use in measurement of cerebral blood flow at the present time. Clinical and laboratory experience with miniature semiconductor systems is reviewed. (auth)

849 INITIAL CHARACTERIZATION OF A MULTI-WIRE PROPORTIONAL CHAMBER POSITRON CAMERA. Lim, C. B.; Chu, D.; Kaufman, L.; Perez-Mendez, V.; Hattner, R.; Price, D. C. (Univ. of California, San Francisco). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 388-394(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Initial results of a research and development effort on a positron camera utilizing 48 x 48 cm^2 multiwire proportional chambers for detecting the annihilation photons that follow positron decay are described. These photons are detected in the chambers by the photons' interaction with specially configured lead converters placed in close proximity to the chamber wire planes, and the coordinates of the interactions are localized by delay line electronics. A spatial resolution of 6 mm FWHM and a resolving time width of 350 nanoseconds have been achieved. Present sensitivity is of the order of 675 counts/min-muCi, with a maximum data rate of 20K counts/min. Scattering medium in the field of view does not significantly degrade performance. Initial in vivo images demonstrate the potential of this camera. (auth)

850 IMAGING WITH A SMALL ULTRA PURE GERMANIUM GAMMA-CAMERA. Kaufman, L. (Univ. of California, San Francisco); Hattner, R.; Price, D.; Swann, S.; Huberty, J.; Armantrout, G.; Camp, D.; McQuaid, J.; Ewins, J. H. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 395-403(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Ultrapure germanium gamma-cameras incorporating delay line readouts can provide system event localization of the order of 2 mm for imaging intermediate energy photons and 4 mm at high energies, with adequate sensitivity. Radioisotopes emitting very high energy photons impose further shielding and collimation requirements which will limit spatial resolution to 6-8 mm. (auth)

851 INSTRUMENTATION FOR A HIGH PURITY GERMANIUM POSITION SENSING GAMMA RAY DETECTOR. Gerber, M. S.; Miller, D. W.; Gillespie, B.; Chemistruck, R. S. (Ohio State Univ., Columbus). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 416-421(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The analysis and design of the instrumentation required to provide spatial and energy information from a high purity germanium,

one-dimensional position sensing gamma ray detector is presented. The results of this study demonstrate that the optimum instrumentation system utilizes Gaussian shaping for the energy channel and Gaussian trapezoidal pulse shaping after antisymmetric summation in the spatial channel. (auth)

852 CdTe DETECTORS IN RADIOIMMUNOASSAY ANALYSIS. Zanio, K. (Hughes Research Labs., Malibu, CA); Montano, H.; Krajenbrink, F.; Peterson, G. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 422-424(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A well was constructed with cadmium telluride detectors and used at room temperature to detect 27.4 keV x-rays from ^{125}I for the purpose of determining the concentration of carcinoembryonic antigen in human plasma. Concentrations were in good agreement with that earlier determined using a NaI well. For individual detectors approximately 1 to 2 cm in area and operating near 0^0C, detector resolutions as low as 3 keV (FWHM) were obtained. (auth)

853 CEREBRAL BLOOD FLOW SYSTEM. Keyser, R. M. (ORTEC Inc., Oak Ridge, TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 425-427(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

This paper describes the ORTEC 4840 Cerebral Blood Flow System. This Na I detector system is used to measure the clearance rate of radioisotopes from brain tissue. This measures the regional cerebral blood flow (Glass and Harper). (auth)

854 INTERFACING CALCULATOR CHIPS TO NUCLEAR-COUNTING SYSTEMS. McDowell, W. P.; Keefe, D. J.; Groer, P. G. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 467-472(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

In the design of nuclear-counting systems it is sometimes desirable to perform simple arithmetic operations on the collected data in order to present it in a more useful form. In many cases these calculations do not require a high-speed processor, and thus can be performed simply and inexpensively through the use of calculator chips. The use of a calculator chip in a portable, battery-operated device designed to measure the radon-daughter concentration in air samples from uranium mines is described. (auth)

855 QUANTITATIVE DYNAMIC RADIOTRACER IMAGING: THE DESIGN AND APPLICATION OF A CLINICALLY PRACTICABLE SYSTEM. Deutchman, A. H.; Miller, D. W.; Hunter, W. W. Jr. (Ohio State Univ., Columbus). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 532-535(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Digital computer processing of nuclear medicine scintillation camera dynamic studies can help extract more diagnostic information and make possible new modes of quantitative data presentation. A simple, inexpensive, off-line digital data acquisition and processing system is designed and constructed which has proven both clinically workable and diagnostically useful. (auth)

856 PIONEER 10/11 AND HELIOS A/B COSMIC RAY INSTRUMENTS. Stilwell, D. E. (Goddard Space Flight Center, Greenbelt, MD); Joyce, R. M.; Teegarden, B. J.; Trainor, J. H.; Streeter, G.; Bernstein, J. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 570-574(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

This paper describes the design and performance of a set of cosmic-ray particle experiments for the Pioneer 10/11 and Helios A/B space missions. These experiments had to be very light-weight, low-power and electronically sophisticated in order to meet the spacecraft and scientific requirements. Both sets of missions use several solid-state detector telescopes to measure protons from approximately 100 keV to approximately 800 MeV and heavier ions up to neon at approximately 200 MeV per nucleon. Good performance is required for 7 to 8 years, and the system must tolerate large vibration loads and ionizing radiation doses up to approximately 5×10^5 rads. (auth)

857 ENERGETIC PARTICLE DETECTOR FOR A SYNCHRONOUS SATELLITE. Aiello, W. P.; Belian, R. D.; Conner, J. P.; Higbie, P. R.; Martin, W. B.; Singer, S. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 575-581(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Energetic Particle Detector (EP) on the DSP satellites consists of four units designed to measure the electron, proton and alpha particle populations at synchronous altitude. The Lo E and Hi E units are sensitive to electrons in the 30 to 300 keV and 0.2 to 2 MeV energy ranges respectively; the Lo P and Hi P units to protons between 100 to 500 keV and 0.5 to 150 MeV respectively. Five Lo E sensors are arranged at angles of 0^0, $+-30^0$, and $+-60^0$ with respect to the spacecraft equator in order to measure the three-dimensional angular distribution of the low energy electrons as the satellite spins. All detectors are silicon semiconductors with well collimated fields of view. The Hi P unit is a telescope of three detector elements which can also measure alpha particles in the energy range 1.2 to 600 MeV upon command. (auth)

858 CLOSED LOOP THRESHOLD CALIBRATOR FOR PULSE HEIGHT DISCRIMINATORS. Peletier, D. P. (Johns Hopkins Univ., Silver Spring, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 592-594(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

This paper describes a simple method of inflight calibration of pulse amplitude discriminator thresholds on satellite-borne particle detection experiments. The calibrator uses the discriminator output as a feedback control signal to adjust the average output of a test pulse generator. The test pulse amplitude is stabilized when the discriminator "half-triggers." The average control voltage is a direct measure of the pulse height discriminator threshold. Better than 1 percent accuracy is obtained over a 50:1 range of discriminator settings. Automatic ranging circuits extend the calibrator dynamic range to 5000:1. (auth)

859 DETECTION UNITS FOR X-RAY RADIATION. den Boggende, A. J. F. (Space Research Lab., Utrecht). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 595-599(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Units for the detection of x-ray radiation are described. Each unit consists of a multiproportional counter detector, a gas supply system and accompanying electronics, including an automatic gas gain-stabilization circuit. In the units detectors filled with Ne/CO_2 as well as Ar/CO_2 gas mixtures are being used. Measures are described to overcome pressure variations in the detector, total as well as partial, due to gas diffusion through the detector window. (auth)

860 SIGMA DATA COMPRESSION. Juergens, D. W. (Ball Brothers Research Corp., Gardena, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 603-604(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A data compression counter which extracts the square root of a number of counts per unit time is presented as an alternative data compression scheme. The maximum error due to compression is equal to the one sigma statistical error. This system should have applications where data bandwidth is low and counting rate dynamic range is high; such as, Gamma Ray Bursts, Solar Flares or, in Exploratory Probes, where the counting rates are unknown. (auth)

861 LARGE AREA DOUBLE SCATTERING TELESCOPE FOR BALLOON-BORNE STUDIES OF NEUTRONS AND GAMMA RAYS. Zych, A. D. (Univ. of California, Riverside); Herzo, D.; Koga, R.; Millard, W. A.; Moon, S.; Ryan, J.; Wilson, R.; White, R. S.; Dayton, B. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 605-610 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A large area (1 m x 1 m) double scattering telescope for balloon-borne research is described. It measures the flux, energy and direction of 2 to 100 MeV neutrons and 0.5 to 30 MeV gamma rays. These measurements are made using time-of-flight and pulse height analysis techniques with two large tanks of mineral oil liquid scintillator. Results from Monte Carlo calculations of the efficiency, energy resolution and angular resolution are presented and the electronics implementation for the processing of 80 photomultiplier tubes signals will be discussed. The

detector weighs 800 kg with a large part of this weight being the liquid scintillator (320 kg). It will be flown at 3 mbars for flight durations up to 40 hours. The first flight is planned for spring, 1975. (auth)

862 LARGE AREA SOFT X-RAY IMAGING SYSTEM FOR COSMIC X-RAY STUDIES FROM ROCKETS. Gorenstein, P. (Harvard College Observatory, Cambridge, MA); Gursky, H.; Harnden, F. R. Jr.; DeCaprio, A.; Bjorkholm, P. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 616-619(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A soft x-ray imaging system consisting of a large area focusing collector and a position sensitive proportional counter has been constructed for cosmic x-ray observations from a sounding rocket. The focusing collector consists of two successive arrays of reflecting plates shaped in the form of nested parabolas. The angular resolution of the system is 3' over a field of 1.5^0. The detector is based on one described by Borkowski and Kopp, and is a two dimensional device that is capable of a spatial resolution of about one millimeter for photon energies exceeding 0.25 keV. (auth)

863 ORIENTED GRAPHITE X-RAY DIFFRACTION TELESCOPE. Trice, J. B.; Locker, R. J. (General Electric Co., Valley Forge, PA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 620-625(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A development program performed during the last year under a contract with the Office of Naval Research has indicated that diffraction focusing of x-rays may offer significant detection advantages when used to focus low energy gamma and x-radiation onto single detectors. The work which supports this conclusion includes a survey of diffraction crystalline materials, diffractometer x-ray measurements of selected crystal specimens, conceptual design studies of x-ray focusing systems, and finally, the fabrication and testing with a radioactive source of a small parabolic focusing array of highly oriented pyrolytic graphite flat crystals. The high diffraction efficiency of oriented graphite even to energies beyond 60 keV has encouraged the development of complete prototype focusing systems. As a part of this continuing effort an eighteen shell oriented graphite laboratory focuser is currently being developed. In order to supply the thousands of square inches of graphite required for this work, a facility has been assembled within General Electric Nuclear Systems Operation at Evendale, Ohio, to produce highly oriented pyrolytic graphite economically and in large quantities. (auth)

864 NaI(Tl)–CsI(Na) PHOSWICH DETECTORS FOR X-RAY ASTRONOMY. Kurfess, J. D.; Johnson, W. N. III. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 626-632(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The design and performance of NaI(Tl)–CsI(Na) phoswich detectors for x-ray astronomy applications are presented. Phoswich techniques enable the design of low-background, actively-shielded detectors of large sensitive area, while maintaining minimum weight and cost. Results from a balloon-borne test flight incorporating several detectors, including one with an effective area of 765 cm^2, are discussed. (auth)

865 BETA–GAMMA COINCIDENCE SYSTEM FOR ENVIRONMENTAL ^{131}I. Paperiello, C. J.; Matuszek, J. M. (New York State Dept. of Health, Albany). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 642-644(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A beta–gamma coincidence system using a thin plastic scintillator and a NaI(Tl) well crystal has been constructed for ^{131}I environmental measurements. A background of 0.01 cpm with a system efficiency of 11 percent has been achieved. The detection limit is 0.08 pCi/l for a 100-minute counting period and otherwise usual conditions. (auth)

866 DESIGN OF A CONTINUOUS DIGITAL-OUTPUT ENVIRONMENTAL RADON MONITOR. Wrenn, M. E.; Spitz, H.; Cohen, N. (New York Univ. Medical Center). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 645-648(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A new field instrument for the continuous measurement of radon concentrations has been developed to investigate the magnitude and variability of environmental levels of ^{222}Rn. Passive diffusion of radon, but not its daughters, occurs through an open pore polyurethane foam into a sensitive volume where a static electric field directs the positively ionized radon daughter products to a central collecting electrode. Pulses in a ZnS(Ag) scintillator, resulting from the alpha emission of ^{218}Po and ^{214}Po, are observed with a photomultiplier tube and counted using standard NIM electronics. The detector unit has been fabricated into a small, convenient package for indoor air sampling without the use of air movers or pumps. The unit is unobtrusive and acceptable into a daily routine without disrupting normal family or business activities. The monitor can detect as little as 0.5 pCi/l for a 40-min. count (alpha equals .05). The equilibrium detection efficiency of the instrument is 0.7 cpm/pCi/l. (auth)

867 CONTINUOUSLY RECORDING FIELD MONITOR FOR KRYPTON-85. Graveson, R. T.; Beck, H.; Freeswick, D. C. (Atomic Energy Commission, New York). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 654-656(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Krypton-85 from nuclear power generation is released to the atmosphere mainly during fuel reprocessing. The monitor described here is designed for use in the vicinity of these facilities. It is battery operated, resistant to weather exposure, and portable. Sensitivity has been verified in the field as 10-20 pCi/liter. The detector array uses two pairs of beta-sensitive dual window pancake GM tubes. One pair is shielded so that it provides a response to gamma photons only. The output of the two channels is stored on a computer-compatible serial magnetic cassette recorder. (auth)

868 PERFORMANCE OF SILVER ZEOLITE IN A RADIOIODINE MONITOR. SooHoo, G. Y.; Lin, C. C.; Norris, R. M.; Wilkinson, C. D. (General Electric Co., San Jose, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 657-660(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Measurements were made of the interaction of ^{85}Kr, ^{133}Xe, CH_3I (^{131}I) and I_2 (^{131}I) with various silver zeolites and activated charcoals under varying relative humidities and temperatures. Results show silver zeolite has significantly less interaction with noble gases and high adsorption efficiencies for CH_3I making it superior to charcoal for airborne radioiodine monitoring. The penetration of airborne iodine activity into the silver zeolite filter bed was also examined. CH_3I penetrated slightly deeper than I_2 at the same air flow velocity; however, at 17.4 feet per minute, no more than 5 percent of the iodine activity in either form penetrated deeper than 1 cm into the filter bed. The sensitivity of the iodine-131 activity detection system was found to be approximately 2.5 percent (1 percent equals 2.22×10^4 counts per minute/muCi) at the 364 keV photopeak with a 100 keV energy window width. (auth)

869 EFFECTS OF MOISTURE ON THE BREAKDOWN-PULSE-NOISE OF MINERAL-INSULATED INSTRUMENT CABLE. Hardtke, F. C. (Univ. of Missouri, Rolla). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 681-685(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Cable resistances (R) and breakdown-pulse-noise (BPN) were measured before, during, and after heating 60-cm portions of a 10-meter mineral-insulated coaxial cable to various temperatures (T), mostly 320^0C. A severe BPN-condition and a very low R within about 60 cm of the high-T end of the cable was shown to be due to atmospheric moisture admitted through an end-seal leak inflicted by a previous test. A similar, but much less severe, BPN-condition 90 to 120 cm removed from either end was attributed to a small amount of moisture that had collected at these positions during the same previous test independent of the end-seal leak. These results suggest that the BPN problem might be eliminated by better hygroscopic measures in cable manufacture. (auth)

870 OPTIMIZATION OF NANOSECOND FISSION ION CHAMBERS FOR REACTOR PHYSICS APPLICATIONS. Hill, N. W.; Mihalczo, J. T.; Allen, J. W.; Chiles, M. M. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 686-690(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

An experimental investigation of the characteristics of parallel plate fission chambers with fast (1–2 nsec rise time) current-pulse

amplifiers has shown that chambers can be constructed which produce pulses with widths of 10 nsec and unambiguous separation of alpha particle pulses from the fission product pulses. Further improvement of this separation by geometric variations in chamber designs is discussed. (auth)

871 DESIGN PARAMETERS AND TEST RESULTS FOR A FISSION COUNTER INTENDED FOR OPERATION UP TO 750°F AT HIGH GAMMA DOSE RATES. Pare, V. K.; Clay, W. T.; De Lorenzo, J. T.; Guerrant, G. C. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 696-701(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A fission counter was built and successfully tested for operation at 750°F and gamma dose rates up to 6×10^8 R/hr. Results from gamma and neutron tests were compared with theoretical predictions and used to optimize the performance of the counters. (auth)

872 NUCLEAR RADIATION DETECTOR FROM SEMICONDUCTING GALLIUM ARSENIDE. Bukki, S. M.; Muminov, R. A.; Shebiot, U. V. Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 74-75(1974). (In Russian).

Investigations are described of semiconductor radiation detectors based on semiinsulating gallium arsenide with a resistivity of 10^7 ohm/cm, a thickness of the sensitive region of 100 to 200 micron and an area of the sensitive surface of 0.75 cm^2. The volt-capacitance and current-voltage characteristics of the detectors are practically linear. The resolving power of the detectors with respect to α particles from a ^{241}Am source amounted to 25 to 50%. In detectors with a width of the sensitive region of 200 micron, the magnitude of the signal is roughly 3 to 4 times smaller than in detectors with a width of the indicated region of 100 micron. It is noted that because of the considerable mobility of the carriers in GaAs it is possible to obtain detectors with a greater resolution time than with detectors based on other materials. (JPRS)

873 INTRODUCTION TO LIQUID SCINTILLATION COUNTING. Neame, K. D.; Homewood, C. Q. London; Butterworth (1974). 188p.

It is stated that the book is intended to provide a straightforward, but comprehensive practical introduction to the technique. Following a short general introduction the subject is covered in chapters entitled: radioactivity, the liquid scintillation counter, counting efficiency and quenching, selection and quantity of tracer, preparation of sample for counting, determination of efficiency (quench correction), double-isotope analysis, random and other errors, danger and protection, equipment and materials. A list of references is appended. (UK)

874 MONTE CARLO CALCULATION OF THE RESPONSE OF THE PORTABLE NEUTRON MONITOR SNOOPY. Tessler, G.; Glickstein, S. S. (Bettis Atomic Power Lab., West Mifflin, PA). Health Phys.; 28: No. 3, 197-204(Mar 1975).

The response function of the portable neutron monitor SNOOPY (polyethylene-moderated BF_3 counter) has been calculated for neutrons in the energy range from thermal to 4 MeV using a three-dimensional Monte Carlo program. The results for a broad beam incident perpendicular to the SNOOPY symmetry axis are in agreement with the published response from 1 eV to 1 MeV. Below 1 eV the calculated response falls below the published curve by an amount which increases with decreasing energy until at 0.025 eV the calculation is low by a factor of 5.5. This discrepancy can be explained as being due to the directionality of the sources used in the calculation (broad beam incident perpendicular to the symmetry axis) and experiment (isotropic source). At 4 MeV the calculation yields an over-response of about 25% which may be due to an inadequate description of the carbon cross-section. For a highly collimated 1 MeV source directed perpendicular to the symmetry axis and incident at the center of the detector, the calculation yields a factor of 2 over-response relative to the broad beam results. As the collimated source is moved away from the center of the detector towards its edges, the response falls off and eventually falls below the broad beam results. Since the calibration of SNOOPY at neutron energies above 30 keV is based on a broad beam measurement, care must be taken when applying the detector in situations where a highly collimated source may exist. (auth)

875 A SEMICONDUCTOR DETECTOR AND A METHOD FOR MANUFACTURING SAME. Cassanhiol, B.; Peyre-Lavigne, A.; Peyre-Lavigne, M. (to CEA). French Patent 2,193,255/E/. 21 Jul 1972. 9p. (In French).

This detector is essentially characterized in that it comprises a guard-ring surrounding the metal deposit acting as a central electrode. This ring consists of a metal deposit insulated from the substrate surface by a thin insulating layer. (auth)

876 COMPARATIVE STUDY OF FOUR TYPES OF CAMERA. Moretti, J. L. (Centre Hospitalier Universitaire, 94 - Creteil (France)); Mensch, B. (Centre Hospitalier Universitaire Saint-Antoine, 75 - Paris (France)); Guey, A. (Hospices Civils, 69 - Lyon (France)); Desgrez, A. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). J. Biol. Med. Nucl.; 9: No. 36, 29-37(1974). (In French).

A certain number of tests likely to show up the general qualities of four commercial cameras were made keeping each time to exactly the same procedure. The cameras investigated are as follows in alphabetical order: Nuclear Chicago 1206 HP 19 PM (1974) NC; Ohio Nuclear 37 PM (1974) ON; Picker Dyna Camera 2 C 19 PM (1974) PI; Toshiba GCA 30 PM (1974) TO. The purpose of the selected tests was to study the intrinsic resolving power of the detectors, the resolving power of the head fitted with the best collimator proposed by the manufacturer for 140 keV, the distortion, counting loss, image disturbances when the counts increase, and the energy resolution. (FR)

877 RADIOPROTECTION SIGNAL POINTS AND ASSOCIATED DATA TREATMENT. Mai Vuong, Q.; Pailhes, A. (Etablissements Merlin et Gerin, 38 - Grenoble (France)); Gueguen, A.; Castri, J.; Leblanc, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements); Cochinal, R.; Hedde, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). pp 539-554 of Le Confinement de la Radioactivite dans l'Utilisation de l'Energie Nucleaire. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French)

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Centralised radiation monitoring proves the most efficient means of ensuring radioprotection in large nuclear plants. Building 120 of the CEN Saclay, which houses the new solid waste processing complex, has been chosen for the pilot experiment to serve future radioprotection units calling on computer techniques. The general design of the system planned is as follows: radioprotection signal points combining a transducer and a signal box are connected to a data centraliser by pulse lines and coded signals. These signal points are distributed, according to the premises to be supervised, into: electron and photon irradiation check points, neutron irradiation check points, atmospheric gas contamination check points and atmospheric aerosol contamination check points. The centraliser, consisting of a mini-computer and its peripherals, concentrates and treats data from the check points and displays the results in terms of maximum tolerance limits. The technical characteristics of the signal points and data centraliser are given. (FR)

878 HEAVY ISOTOPE MIXTURE FOR FISSION CHAMBERS. Guery, M.; Robin, M.; Vidal, R. (to CEA). French Patent 2,192,319/A/. 10 Jul 1972. 6p. (In French).

A mixture of heavy isotopes intended for coatings in fission chambers is proposed. This mixture is characterized in that it comprises at least one fissile heavy isotope and at least one heavy isotope capable of providing a fissile isotope under the action of a neutron flux so that the sum of the fission cross sections of the isotopes remains substantially constant with time for a given neutron spectrum. According to another embodiment, the mixture contains from 20% to 30% uranium 235, the balance being 234 uranium. According to another embodiment, the mixture contains thorium 232 and uranium 233. This mixture can be applied to the measurement of neutron fluxes in reactors. (FR)

879 FREQUENCY ANALYSIS AND SCINTIGRAPHY PROCESSING. I. Theory and Fundamental Problems. Berche, C.; Di Paola, R. (Institut Gustave Roussy, 94 - Villejuif (France). Lab. des Isotopes). J. Biol. Med. Nucl.; 9: No. 36, 16-28(1974). (In French).

An approach of scintigraphy processing can be made with frequency analysis. A theoretical study of this question and a model for the scintigraphic system using properties of Fourier transform is presented. (FR)

880 TWO-DIMENSIONAL READOUT SYSTEM FOR RADIATION DETECTOR. Lee, L. Y. (to United States Energy Research and Development Administration). US Patent 3,873,838. 25 Mar 1975. Filed date 22 Apr 1974. 6p.

A two dimensional readout system has been provided for reading out locations of scintillations produced in a scintillation type radiation detector array wherein strips of scintillator material are arranged in a parallel planar array. Two sets of light guides are placed perpendicular to the scintillator strips, one on the top and one on the bottom to extend in alignment across the strips. Both the top and bottom guides are composed of a number of 90° trian-

gular prisms with the lateral side forming the hypotenuse equal to twice the width of a scintillator strip. The prism system reflects light from a scintillation along one of the strips back and forth through adjacent strips to light pipes coupled to the outermost strips of the detector array which transmit light pulses to appropriate detectors to determine the scintillation along one axis. Other light pipes are connected to the end portions of the strips to transmit light from the individual strips to appropriate light detectors to indicate the particular strip activated, thereby determining the position of a scintillation along the other axis. The number of light guide pairs may be equal the number of the scintillation strips when equal spatial resolution for each of the two coordinates is desired. When the scintillator array detects an event which produces a scintillation along one of the strips, the emitted light travels along four different paths, two of which are along the strip, and two of which are through the light guide pair perpendicular to the strips until all four beams reach the outer edges of the array where they may be transmitted to light detectors by means of light pipes connected therebetween according to a binary code for direct digital readout. (Official Gazette)

881 SCANNING DEVICE FOR SCINTIGRAPHY. Casale, R. (to Ital Elettronica S.p.A.). US Patent 3,870,886. 11 Mar 1975. Priority date 28 Jul 1971, Italy. 8p.

A device is described for the scintigraphic scanning according to a horizontal plane, comprising: (a) A support provided with two guides horizontally and longitudinally located, one of which is located in the upper part of the support, while the second guide is located in the lower part of the support; (b) A carriage, movable with respect to the support along the two guides, provided in its upper part, projecting above the support, with rolling means suitable to support and to cause to slide along its axis a support rod for the first detector, horizontally and transversely located, said carriage being further provided in its lower part with a recess with possible rolling means suitable to support and to cause to slide along its axis a second support rod for the second detector, said second rod being located parallel to the first rod and below it; (c) One or two support rods for the detectors, the first of said rods being supported above the support in a sliding way along its axis, by the rolling means located in the upper part of the carriage, and the second rod if present is supported slidingly along its axis by the possible rolling means contained in the suitable recess which is provided in the lower part of the carriage, and (d) A vertical shaft supported by said carriage on which is mounted a toothed wheel for each rod, each toothed wheel engaging a positive drive belt or the like, which is connected to each said rod so that rotation of the shaft determines the simultaneous displacement of the two rods along their axes; and single motor means for driving said shaft during a scanning operation. (Official Gazette)

Radiation Dosimeters

Refer also to abstracts 130, 990, 1636–1638, 2126, and 2131.

882 (AD/A-002724) RADIATION AND CHEMICAL DETECTORS. Goritskii, A. P. 27 Sep 1974. Translation of Pribory Radiatsionnoi i Khimicheskio Razvedki, Moscow, 1969. (FSTC-HT-23-2256-72). 92p. NTIS $4.75.

883 (AED-CONF-74-509-029) NEW CHARACTERISTICS FOR CELLULOSE NITRATE FILM AS A NEUTRON RECOIL TRACK DETECTOR. Hassib, G. M.; Medveczky, L. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). 1974. 12p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract. Available from ZAED.

The characteristics of the coloured cellulose nitrate film "Kodak LR-115" as a neutron recoil track dosimeter with a rad response have been investigated. The present studies are based on the direct interaction of neutrons with the nuclei of the detector materials. Samples of LR-115 film were exposed to different neutron spectra, covering the energy range between 1.4 MeV to 14 MeV, and etched in 10% NaOH at 60°C for different durations. The neutron fluence was measured simultaneously, using a calibrated fission track detector. The variation of the detector sensitivity as a function of neutron energy was investigated. This function had matched the rad per unit fluence curve at all energies. (auth)

884 (AED-CONF-74-509-037) DIFFERENT SENSIBILITIES OF THERMOLUMINESCENT, PHOTOLUMINESCENT AND PHOTOGRAPHIC DETECTORS TO NEUTRONS. Spurny, F.; Medioni, R.; Portal, G. (Ceskoslovenska Akademie Ved, Prague. Laborator Radiologicke Dozimetrie). 1974. 7p. (In French). INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

Thermoluminescent, photoluminescent and photographic detectors are widely used in gamma dosimetry. In mixed fields the response varies due to different sensibility to neutrons. It is therefore necessary to correct the results to find the exact gamma dose. For the above-mentioned dosemeters, their sensibility to thermal neutrons from a swimming-pool reactor and to fast neutrons from a ^{252}Cf-neutron source and from an accelerator (14.7 MeV neutrons) was studied experimentally. (GE)

885 (AED-CONF-74-509-038) THE USE OF TRANS-STILBENE SCINTILLATORS FOR THE MEASUREMENT OF DOSE IN γ-n MIXED FIELDS. Ianni, A.; Merolli, S.; Roccella, M.; Tarpignati, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 1974. 10p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

6 figs.; 10 refs. With abstract.

The possibility of employing a trans-stilbene crystal scintillator in the dosimetry of γ-n mixed fields has been studied. By a suitable linear combination of the slow and fast components of the light pulse, a response can be obtained to protons and to γ-rays that makes feasible the use of the scintillator for the measurement of the equivalent dose in γ-n mixed field. The energy range that can be covered is from 0.1 up to 5 + 6 MeV for γ-rays and from 0.1 up to 12 + 14 MeV for neutrons. (GE)

886 (JAERI-M-5608) CALIBRATION OF THE CTA FILM DOSIMETER FOR ^{60}Co GAMMA-RAYS AND ELECTRON BEAM. Tanaka, R.; Yotumoto, K.; Tajima, S.; Kawai, M.; Mizuhashi, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 32p. INIS.

The CTA (cellulose triacetate) dosimeter has been calibrated for both ^{60}Co gamma-rays and 1.5 MeV electron beam in the mega-rad region. The calibration for gamma-rays is by two methods, i.e., with ionization chamber or Fricke dosimeter. Agreement between the two methods is good within experiment uncertainty. For electron beams the calibration is by relative depth dose curve in CTA normalized by the energy fluence determined by two methods, i.e., beam current measurement or calorimetry. The results are also in good agreement. The calibration constant differentiates between gamma-rays and the electron beam, which indicates that the response of a CTA dosimeter is dependent on the dose rate. Corrections for the gamma-rays exposure rate and the electron beam intensity and the uncertainty in their values are also discussed. (auth)

887 (ORNL-TM-4887) INTERNATIONAL INTERCOMPARISON OF ENVIRONMENTAL DOSIMETERS UNDER FIELD AND LABORATORY CONDITIONS. Gesell, T. F.; de Planque Burke, G.; Becker, K. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 31p. Dep. NTIS $4.75.

Based on the results of a pilot study at ORNL in 1973, a more comprehensive international intercomparison of integrating dosimeters for the assessment of external penetrating environmental radiation fields was carried out. Forty-one laboratories from eleven countries participated in this study. A total of 56 sets of six detectors each were mailed to and from Houston, Texas, where they were exposed for three months (July to September 1974) as follows: two in an unprotected space out-of-doors 1 m above ground; two in an air-conditioned shielded area with a known, low exposure rate; and two with the second group, but with an additional exposure to 30 mR. Evaluation of the dosimeters provides information on the calibration precision, the accuracy of field measurement, and transit exposure. Results are discussed. (auth)

888 INVESTIGATION OF CHEMICAL DOSIMETRY METHODS FOR INTENSE GAMMA RADIATION. Bologova, G. S.; Vasil'ev, A. G.; Nikolaeva, R. A.; Trusova, V. P. Int. J. Radiat. Eng.; 1: No. 1, 81-86(Jul 1971).

The dosimetric characteristics of several established and new dosimetric systems were investigated, in relation to the effects of temperature and of atmosphere. In some cases an analytical equation was derived for the relation between dose and dosimetric parameters. The systems considered were ferrous sulfate, oxalate, PMMA (viscosity and absorbance), cellulose, triacetyl cellulose, and glucose (solution and crystalline powder). (auth)

889 SYNTHESIS OF DEFECTS IN IRRADIATED QUARTZ. Ichikawa, Y. (Nara Univ. of Education, Japan). Int. J. Radiat. Eng.; 1: No. 6, 605-608(Dec 1971).

Glow curves of natural quartz irradiated by γ-rays were observed at various doses and each glow peak was resolved into three component peaks, B_1, B_2 and C. The glow peaks caused by the diffusion of impurities at 1000°C were compared with these

peaks and the nature of the defect responsible for each peak was determined. The defects for the B_1 peak were associated with the Al-defect, the defects for the B_2 peak were attributed to the disturbed-network in the vicinity of Li and the defects for the D peak—to oxygen vacancy. Moreover, the interaction of these defects was discussed under consideration of the variation of the areas of glow curves for various doses. (auth)

890 PROPERTIES OF QUARTZ THERMOLUMINESCENCE DOSIMETERS. Ichikawa, Y.; Morii, T. (Nara Gakugei Univ., Japan). Int. J. Radiat. Eng.; 1: No. 6, 599-604(Dec 1971).

The present investigation was undertaken as a preliminary experiment to use quartz as a thermoluminescence dosimeter. The glow curve resulting from natural Brazilian quartz showed three glow peaks at approximately 110, 220 and 310°C. The second peak of the three has been found the most desirable one from a viewpoint of dosimetry in the case of an accident. In the case of normal dosimetry the susceptibility of quartz for radio-thermoluminescence could be increased by irradiation with ^{60}Co gamma rays at a large dose (1×10^7r). This dosimeter has the advantage of low fading because of the high peak-temperature (280°C) and of excellent linearity to the absorbed dose up to 1×10^4r at least. (auth)

891 RADIATSIONNAYA BEZOPASNOST'. Velichiny, Edinitsy, Metody I Pribory. (Radiation Safety. Quantities, Units, Methods, and Instruments). Keirim-Markus, I. B. (ed.). Moscow; Atomizdat (1974). 140p.

This book is a translation of reports 19 and 20 of the International Commission on Radiation Units (ICRU). A presentation is given of new determinations of values and units of measurement in the dosimetry of ionizing radiation, which can be used in radiology, radiobiology, radiation safety and other fields of science utilizing ionizing radiation. Particular attention is devoted to the equivalent dose of mixed radiation. Practical recommendations are given for the first time on the correct selection and use of instruments for the measurement of radiation values which are applicable to different kinds of sources and radiation. A description is given of instruments and methods used to obtain the equivalent dose of high-energy particles. (SJR)

892 THERMOLUMINESCENCE IN LiF. Sensitization Useful at Low Exposures. Mayhugh, M. R.; Fullerton, G. D. (Univ. of Wisconsin, Madison). Health Phys.; 28: No. 3, 297-299(Mar 1975).

An annealing procedure is reported whereby a five-fold improvement in the lowest exposure detectable with LiF dosimetry is achieved. The method consists of pre-irradiation followed by uv-anneal, (ultraviolet illumination during annealing near 300°C) to give a new sensitizing procedure. This treatment eliminates interfering centers but maintains increased sensitivity. The procedure is simple and inexpensive. (UK)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 2110 and 2818.

893 (CEA-R-4656) STUDY OF DIFFERENT PROBLEMS SET BY THE PRECISE CALIBRATION OF A γ SPECTROMETER. Application to the ^{152}Eu γ Rays Energy and Absolute Intensity Measurements. Morel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Chimie). Mar 1975. 103p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis.

The different problems set by the precise calibration of a Ge-Li detector spectrometer are discussed. The design of the spectrometer and the different factors which affect the quality of the results are discussed including experimental conditions reproducibility, data treatment, standards choice, and errors bound to the instrumentation or to the decay schemes. The calibrated spectrometer was used for the determination of the energies and the absolute intensities of the ^{152}Eu γ rays, so that this radionuclide could be used, as a single reference, for the quick and precise calibration of γ spectrometers. (auth)

894 (JINR-P6-8564) MEASUREMENT SYSTEM FOR SPECTROSCOPIC INVESTIGATIONS OF NUCLEI FAR FROM THE β-STABILITY LINE. Andert, K.; Arit, R.; Gonusek, M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 32p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The construction principles and characteristics are given for a number of spectrometers intended for measurements of γ-, β- and e^--radiation arising at the decay of short-lived isotopes produced using the synchrocyclotron. Semiconductor and scintillation detectors are used to detect the radiation. The spectra are measured both in one dimensional and in multidimensional modes. The developed system of programs allows the rapid preliminary data processing and the optimization of the experimental setup on-line with a small computer. (auth)

895 (ORNL-TM-4871) CRUNCHER: A CHANNEL COMPRESSION DEVICE FOR TIME OF FLIGHT EXPERIMENTS. Remez, L. A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 87p. Dep. NTIS $7.50.

The device described performs a variable "channel compression" operation on the binary data provided by a time digitizer (EGG TDC-100) before this data is fed to an on-line data acquisition computer (SEL 810B). In this way, original data requiring 26 lines for transmission and over 67 million channels for storage can be transmitted over 15 lines to less than 33000 storage channels (in the maximum compression mode) without loss in data quality (resolution) for normal experimental conditions. There are also significant savings of central processor time per data, which would be otherwise "crunched" by a software routine. This last feature is particularly interesting for time-shared data acquisition systems. (auth)

896 (WANL-TME-2784) COMPUTER PROGRAM FOR UNFOLDING NaI PULSE-HEIGHT SPECTRA. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1971. 69p. Dep. NTIS $6.50.

Three computer subprograms used to unfold the pulse-height response of NaI detectors to gamma rays are given. Subprogram RMTRX2 generates the response matrix of the detector from the pulse-height data due to a few calibration gammas of standard energies. The role of subprogram PLTS is to prepare the input to RMTRX2. Given an experimental pulse-height distribution and the response matrix of the detector, subprogram ITER solves for the energy spectrum of the radiating gamma source by applying the iterative unfolding technique developed by N. E. Scofield. (auth)

897 NEUTRON SPECTROMETRY BY DIAMOND DETECTOR FOR NUCLEAR RADIATION. Kozlov, S. F.; Konorova, E. A.; Barinov, A. L.; Jarkov, V. P. (Lebedev Inst. of Physics, Moscow). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 171-172(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Experiments on fast neutron spectrometry using the nuclear radiation diamond detector inside a horizontal channel of a water-cooled and water-moderated reactor are described. It is shown that the diamond detector enables neutron spectra to be measured within the energy range of 0.3 to 10 MeV against reactor gamma-radiation background and has radiation resistance higher than that of conventional semiconductor detectors. (auth)

898 AMBIENT TEMPERATURE ISOELECTRONIC DETECTORS: STATUS AND PROSPECTS. Armantrout, G. A.; Chau, H. H.; Yee, J. H. (Lawrence Livermore Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 65-67(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Potential use of high-Z semiconductor detectors operating in the charge collection mode as gamma-ray spectrometers at ambient temperatures appears to be limited by charge collection problems. Improvements in present scintillators through improved linearity and higher fluorescent efficiency appear possible. T. C. Madden, et al., suggested the use of isoelectronic scintillators as an improved scintillator material. We have studied the possibility of using one of these, Te doped CdS, as a gamma-ray spectrometer. (auth)

899 HIGH RESOLUTION CHARGED PARTICLE SPECTROSCOPY WITH SIDE-ENTRY Ge(Li) DETECTORS IN THE ENERGY RANGE OF THE JUELICH CYCLOTRON. Riepe, G.; Protic, D. (Kernforschungsanlage, Juelich, Ger.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 178-181(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Planar Ge(Li) detectors of side-entry type were prepared with the aim of minimizing dead layer effects. The cryostat employed was connected to a scattering chamber without the use of a window. Detector resolution was determined for protons of 44.1 MeV, deuterons of 62.9 and 80.7 MeV and alpha-particles of 155.5 MeV, elastically scattered on a Au target under THETA theta/sub lab/ equals 15^0, as well as for 83.9 MeV protons from a (d,p)-reaction. Overall resolution figures DELTA E(fwhm)/E, comprising contributions from experimental set-up and detector system, were in the range from 3.4 to 4.4×10^{-4}. (auth)

900 PROPERTIES OF VAPOUR PHASE GROWN MERCURIC IODIDE SINGLE CRYSTAL DETECTORS. Ponpon, J. P.; Stuck, R.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 182-191(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The growth of red mercuric iodide single crystals by a dynamic sublimation method is described. Their characterization has been performed by means of optical and electrical measurements. Nuclear radiation detectors have been prepared with this material and their properties are evaluated in terms of alpha particles, gamma- and X-rays spectrometry, detection efficiency, electron-hole pair creation energy and polarization effects. Finally the potential use of mercuric iodide in nuclear detection is discussed. (auth)

901 PROGNOSIS FOR HIGH-Z SEMICONDUCTOR DETECTORS. Swierkowski, S.P.; Armantrout, G. A. (Lawrence Livermore Lab., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 205-210(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Considerable interest has been generated recently in the use of high-Z semiconductors for x-ray spectroscopy. To aid in this study, a Monte-Carlo computational model has been used to simulate x-ray spectral response in semiconductor detectors. The model employs one-dimensional charge collection in an arbitrary electric field profile and includes trapping and electronics system effects. Spectra are calculated for several materials, including HgI_2 and CdTe, and are compared to experimental results. (auth)

902 CADMIUM TELLURIDE NUCLEAR RADIATION DETECTORS. Siffert, P. (Centre de Recherches Nucleaires, Strasbourg); Cornet, A.; Stuck, R.; Triboulet, R.; Maraing, Y. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 211-225(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The characteristics and performance of undoped high resistivity cadmium telluride detectors are compared to chlorine compensated counters. It is shown, in particular, that "undoped" CdTe is in fact aluminium doped and that compensation occurs, as in silicon or germanium, by pair and triplet formation between the group III donor and the doubly charged cadmium vacancy (V^{2-}/sub Cd/) acceptor. Furthermore, in chlorine doped samples, the polarization effect results from the unpaired (V^{2-}/sub Cd/) level at E/sub c/ − 0.6 eV. (auth)

903 INVESTIGATION OF THE COUNT RATE PERFORMANCE OF BASELINE RESTORERS. Karlovac, N. (ORTEC, Inc., Oak Ridge, TN); Blalock, T. V. IEE Trans. Nucl. Sci.; NS-22: No. 1, 457-462(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The characteristics of baseline restorers (stabilizers) at high count rates were investigated. The analyses included both of the basic types of baseline restorers: 1) the non-linear circuit realizations (BLR), and 2) the time-variant stabilizers based on the gated differentiator concept. The advantage of the TVS over the BLR was demonstrated. Two new count rate effects were described. One is the count rate dependence of the noise error introduced by the stabilizer. Another one is the count rate dependent low frequency noise, which causes a reduction of the effectiveness of baseline restorers in cancelling low frequency interference at high count rates. (auth)

904 GATED BASELINE RESTORER WITH ADJUSTABLE ASYMMETRY. Fairstein, E. (Tenelec, Inc., Oak Ridge, TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 463-466(Feb 1975).

From 21th nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A baseline restorer (BLR) for pulse amplifiers is described in which current to the memory capacitor can be gated off during a pulse. This technique reduces the BLR recovery time without introducing artifacts when a short-period undershoot accompanies in input signal. The gating and reset thresholds are adjustable, as is the BLR symmetry. Tests with a pulse generator show that the baseline shift with 5V pulses at duty factors up to 75 percent is less than 1mV. When the signal source is a radiation detector, the gated BLR is usable at duty factors up to 90 percent. (auth)

905 ANS HARD X-RAY EXPERIMENT. Kubierschky, K.; Jagoda, N.; Austin, G. K.; Parsignault, D. R.; Frank, R.; Ballas, J. S. (American Science and Engineering, Inc., Cambridge, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 551-554(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The ANS Hard X-Ray Experiment is an x-ray spectrometer gathering astronomical data through two pairs of proportional counters. One set of detectors obtains both spectral and spatial resolution by Bragg reflection. The other pair obtains spatial resolution with a compound collimator and spectral resolution by means of pulse-height analysis. (auth)

906 INSTRUMENT FOR MEASURING COSMIC X-RAY RADIATION. den Boggende, A. J. F.; Lafleur, H. T. J. A. (Space Research Lab., Utrecht). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 555-559(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The instrument is able to measure cosmic x-ray radiation in two channels between 0.15 and 0.46 keV, and in five channels between 0.8 and 8 keV. It consists of two detection units together with a data handling unit. One detection unit comprises a 150 cm^2 multiproportional counter detector with a 1.8 micron titanium window operating with a gas mixture of Ne + 10 percent CO_2. The other unit comprises a 7 cm^2 multiproportional counter detector with a 3.6 micron (Al and C) coated polypropylene window, operating with a gas mixture of Ar + CO_2. A 144 cm^2 collecting mirror is placed in front of the last detector. A regulated high voltage supply as well as a gas supply system have been added to each of the detectors. The instrument has been prepared for the Astronomical Netherlands Satellite (ANS), which was launched on August 30, 1974. (auth)

907 ATMOSPHERE EXPLORER PHOTOELECTRON SPECTROMETER. Peletier, D. P. (Johns Hopkins Univ., Silver Spring, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 560-564(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Photoelectron Spectrometer (PES) is part of the complement of scientific instruments aboard three NASA Atmosphere Explorer (AE) satellites that are intended to enhance understanding of the physics of the earth's upper atmosphere. The spectrometer is designed to measure the energy spectrum, angular distribution, and intensity of electrons in the earth's thermosphere. It measures energies between 2 and 500 eV at altitudes as low as 130 km. In addition, it is the first satellite instrument to obtain high resolution data about electrons in the 2- to 10 eV energy range. (auth)

908 MASSACHUSETTS INSTITUTE OF TECHNOLOGY X-RAY OBSERVATORY FOR THE SMALL ASTRONOMY SATELLITE (SAS-C). Taylor, R. S. (MIT Center for Space Research, Cambridge, MA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 565-569(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The MIT SAS-C X-Ray Observatory is a highly flexible facility for the comprehensive study of the x-ray sky over the 0.1 to 50 keV energy range. Event time may be determined to 0.125 ms. An on-board 16 pulse height analyzer allows for fine x-ray spectral studies using the on-board star trackers and rotating modulation collimator. Both risetime and geometric anticoincidence circuits are employed and a programmable data format generator allows great flexibility in choice of data sources and source sampling rate for special studies. (auth)

909 HYBRID MEASUREMENT CHAINS FOR THE SAS-C SPACECRAFT. Goeke, R. F. (Massachusetts Inst. of Tech., Cambridge). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 600-602 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Spacecraft electronic systems usually demand tight packaging. It was this consideration which initially forced us to consider hybrid circuits for the analog signal processing circuits in the Small Astronomy Satellite-C (SAS-C) scientific payload. We gradually discovered that increased reliability, low power consumption, and reduced program costs all followed. This paper attempts to share the Laboratory's first experience with hybrid

circuits and indicate those areas which were found to be important. (auth)

910 Si(Li) DETECTOR SYSTEM FOR APPLICATION TO X-RAY ASTRONOMY ROCKET EXPERIMENTS. Griffiths, R. E. (Leicester Univ., Eng.); Cheron, C.; Friant, A.; Jehanno, C.; Rocchia, R.; Rothenflug, R.; Testard, O. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 611-615(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The problems associated with the use of Si(Li) detectors in x-ray astronomy rocket experiments are discussed. In particular a detector system is described that can be used at the focus of a grazing-incidence paraboloid telescope for the energy range 0.3 to 2 keV. (auth)

911 HIGH-RESOLUTION LIQUID SCINTILLATION METHOD FOR THE ANALYTICAL DETERMINATION OF ALPHA-EMITTERS IN ENVIRONMENTAL SAMPLES. McDowell, W. J. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 649-653(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Appropriate optical and electronic components used in conjunction with an improved scintillator solution allow alpha liquid scintillation spectroscopy with an energy resolution of 200 to 300 keV and a background of 0.01 to 0.005 cpm. Liquid-liquid extraction procedures allow selective extraction of nuclides of interest directly into the scintillator. Applications to environmental samples are illustrated. (auth)

912 NaI(Tl)-Ge(Li) COINCIDENCE GAMMA-RAY SPECTROMETRY FOR RADIONUCLIDE ANALYSIS OF ENVIRONMENTAL SAMPLES. Brauer, F. P.; Kaye, J. H.; Fager, J. E. (Pacific Northwest Labs., Richland, WA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 661-670(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A multi-parameter NaI(Tl)-Ge(Li) coincidence gamma-ray spectrometry system has been developed for the analysis of environmental samples from nuclear power industry radioactive effluents. Several detector configurations have been evaluated. Data acquisition is by buffer storage of the ADC output and final recording of each event in list mode on magnetic tape. A 16K computer and a 4096 channel, pulse height analyzer are used for accumulation of spectra from the data on magnetic tape. Display and software routines aid in the analysis of the spectral data. The system has been used to study environmental radiochemical analysis problems. (auth)

913 A METHOD FOR MEASURING THE ENERGY OF HIGH ENERGY GAMMA RAYS. Forcinal, G. (to La Radiotechnique Compelec (RTC)). French Patent 2,191,132/A/. 6 Jul 1972. 10p. (In French).

The description relates to a method for measuring the energy of high energy gamma rays by means of a measuring device essentially comprising a sensing member formed of three semiconducting detectors of the N.I.P.-type associated to an appropriate electronic device, said method being characterized in that the energy pulses treated are those of at least two of these three detectors. (FR)

High Energy Physics Instrumentation

Refer also to abstracts 595 and 1640.

914 (CEA-N-1700, pp 144-146) A DOUBLE 50cm DRIFT COUNTER. Duchazeaubeneix, J. C.; Laspalle, C.; Legrand, J.; Saudinos, J. [nd]. (In French).

In progress report. 1 October 1972-30 September 1973.

The double 50 cm drift counter used in the 1 GeV experiment is described. The spatial resolution is 0.4 mm up to 12 cm drift length and 1.3 mm at 50 cm drift lengths. The 5 μs memory time of the counters is not a limitation because they are used in multiple coincidence (τ = 45ns). (FR)

915 (CNEN-LNF-73-36) ENERGY LOSS SPECTROMETER FOR LOW ENERGY PION SCATTERING. Barbini, R.; Faini, S.; Guaraldo, C.; Schaerf, C.; Scrimaglio, R (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 13 Jun 1973. 23p. INIS.

The performance of an energy loss spectrometer is reported together with a detailed discussion of the basic parameters of such a system and in particular the second order aberrations. The system constructed consists of two uniform field seventy degree bending sectors in a configuration symmetrical to first order, with an image point in the symmetry plane. The system has been tested with the LEALE-LNF low energy positive and negative pion beams. The magnets were set at zero degrees facing each other. The contributions of the aberrations and of multiple Coulomb scattering in air, helium and thin windows to the momentum resolution of the two magnets system have been evaluated and the total momentum resolution compared with the experiment at various energies for positive and negative pions. (INIS)

916 (ISS-L-74/7) HIGH-ENERGY BEAMS AND MAGNETIC SPECTROMETERS. Part I. Matthiae, G. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 20 Aug 1974. 66p. (In Italian). Dep. NTIS (US Sales Only) $6.50.

Lectures on the properties of dipole and quadrupole magnets are discussed together with their combined use in the beam transport systems. Commonly used methods of magnetic analysis are reviewed. Several examples of charged particle spectrometers are discussed. (auth)

917 (ITEP-28) PARTICLE SHOWER DETECTOR: THE MULTIPLATE STREAMER CHAMBER. Weissenberg, A. O.; Dyaon, M. I.; Egorov, O. K.; Krilov, S. A.; Makarov, L. G.; Smirnitskii, V. A.; Sheynkman, V. A.; Euschenko, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 12p. INIS.

The electron shower detection properties of the multiplate streamer chamber were studied. In a magnetic field such a chamber with several plates of heavy matter with a total of 2 to 3 radiation lengths provides reliable and hear 100% identification of the electrons with energies about 200 MeV. (auth)

918 (JINR-P13-8267) HELIUM STREAMER CHAMBER WITH ADMIXTURES OF CCl_4. Busso, L.; Godunova, E. S.; Kulyukin, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The influence of small admixtures of CCl_4 on the operation of a helium-filled streamer chamber was investigated. It was established that CCl_4 may be used effectively in a helium streamer chamber for regulating the memory time, for increasing the track contrast, and for suppressing the parasite luminosity near the walls of the chamber. (auth)

919 (JINR-P13-8390) THREE-GAP SPARK DISCHARGER FOR SPARK CHAMBER SUPPLY. Alekseev, G. D.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The properties of the three-gap air spark discharger were investigated. It is shown that the discharger is effective in a wide range of supply voltage and has (depending on the voltage) a switch delay $\bar{t}$ = 30 to 60 ns, jitter $\Delta = 7/15$ ns. The rise time of the output pulse is about 10 ns. The discharger is reliable in operation, durable, and simple in construction. (auth)

920 (LNF-74/43(R)) HADRON FRAGMENTATION AT SPS: A STUDY OF VERTEX DETECTOR. Pattern Recognition and Events Reconstruction Criteria. Bologna, G.; D'Ettorre Piazzoli, B.; Fabbri, F. L. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 27 Jul 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

The multiparticle spectrometer, general criteria for pattern recognition and event reconstruction in the vertex detector (multiwire proportional chamber stack), and some results obtained with the pattern recognition program are described for experiments on hadronic multiparticle production in the projectile fragmentation and pionization region induced by different particles on protons and nuclei at the CERN SPS. (WHK)

921 GAS-CHERENKOV COUNTER FOR μ-e DISCRIMINATION IN AN EXPERIMENT TO DETERMINE THE $K \rightarrow e\nu/\mu\nu$ BRANCHING RATIO. Kalbreier, W. Heidelberg; Univ. Heidelberg (1973). 57p. (In German). INIS.

Thesis.

The construction of the gas-Cherenkov counter, its use in the experiment, and the calibration are described. (GE)

922 STATE OF THE ART OF DRIFT CHAMBERS. Walenta, A. H. (Univ., Heidelberg). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 251-254(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The basic properties of drift chambers such as space resolution are discussed. The performance of various types of drift chambers is reported, e.g. chambers with high space and time resolution (DELTA x equals 0.25 mm fwhm, DELTA t equals 6.3 ns fwhm), very large area chambers (ca. 16 m^2) for a neutrino experiment, cylindrical chambers for colliding beam experiments. (auth)

923 X-Y MULTIWIRE PROPORTIONAL CHAMBER (MWPC) WITH DELAY LINE READOUT FOR THE MAGNET-SPECTROGRAPH OF THE JULIC CYCLOTRON. Koehler, M.; Mueller, K. D.; Teske, M. (Zentrallabor fuer Elektronik, Juelich, Ger.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 272-276(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A MWPC with an active area of 30 x 4 cm^2 has been developed using two-dimensional delay-line readout. To avoid the problems associated with long wires, the anode and cathode wires are oriented at 45^0 to the X and Y axes; this is important for further extension in one direction. New electromagnetic delay lines for wire chamber readout with high bandwidth and low attenuation are used. The X-Y spatial resolution has been measured to be about 0.5 mm FWHM. (auth)

924 LARGE NaI(Tl) CRYSTALS AS HIGH ENERGY RESOLUTION SPECTROMETERS IN HIGH ENERGY PHYSICS AND IN gamma-RAY ASTRONOMY. O'Neill, L. H.; Ford, R. L.; Hofstadter, R.; Hughes, E. B.; Kose, R.; LeCoultre, P.; Martin, T. W.; Schilling, R. F. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 286-291(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The response of 30 in. diameter NaI(Tl) crystal detectors to electrons in the GeV range is described, and experience acquired in the operation of such detectors in physics experiments is summarized. (auth)

925 MULTIWIRE PROPORTIONAL CHAMBER TRIGGER SYSTEM FOR A RAPID-CYCLING BUBBLE CHAMBER. Coombes, R. (Stanford Univ., CA); Hitlin, D.; Porat, D.; Anderson, K.; McQuate, D.; Morse, R.; Mugge, M.; Schultz, G.; Cowell, P.; Dorfan, J. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 292-296(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A cylindrical multiwire proportional chamber operating within the vacuum tank of a rapid-cycling bubble chamber is described. The system is used in conjunction with the SLAC K^0-spectrometer to allow the selection of event topologies of several types of K^0/sub L/ p reactions having small cross sections (approximately 0.1 to 1 mb) in comparison with the total cross section (approximately 25 mb). Construction of the chamber, its electronics, data acquisition, and operational characteristics are presented. (auth)

926 HIGH-DENSITY DRIFT SPACES. Jeavons, A. P.; Charpak, G.; Stubbs, R. J. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 297-300(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Multiwire proportional chambers, with high-density drift spaces attached, have been developed as position-sensitive detectors for non-ionizing radiation. A chamber with a 5 g/cm^3 drift space comprising a lead-bismuth converter of 0.8 mm round holes on a 1 mm pitch has been investigated. The detection efficiency is 14 percent at 0.5 MeV, rising to 18 percent at 0.66 MeV, with a spatial resolution of 1 mm. Higher efficiencies are possible. These chambers offer new possibilities for photon and neutron detection, and for shower detectors for high-energy particles. (auth)

927 MODULAR (AMPLIFIER PER WIRE) WIRE CHAMBER AND READOUT SYSTEM. Cairns, E. B.; Dawson, W. K. (Univ. of Alberta, Edmonton). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 301-302(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The experimental program at the TRIUMF 500 MeV proton cyclotron requires the use of many different wire chamber configurations. Thus it was decided to attempt a standardized format for producing these chambers and their associated readout electronics. A few basic parameters were established such that mask preparation costs and time could be kept to a miminum. The system that has evolved while having a standardized electrical and mechanical format also has the required flexibility. (auth)

928 HARDWARE SCATTER DETECTOR. Dhawan, S.; Majka, R. (Yale Univ., New Haven). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 303-305(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A fast analog processor for use in a high energy small angle scattering experiment is described. The processor uses data from high resolution multiwire proportional chambers to select beam tracks inside "good" phase space and measures the scattering angle. The result of the calculations is available within 5 mu s. (auth)

929 HIGH ACCURACY PARALLEL FOIL DRIFT CHAMBER. Atac, M.; Ankenbrandt, C. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 306-308(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A 50 x 50 cm^2 area 1 cm drift spacing High Accuracy Parallel Foil Drift Chamber was built and successfully operated. This chamber produces an overall average spatial resolution sigma equals 80 mu m in the entire drift space. This type of drift chamber has excellent field uniformity in the electron drift region, high count rate capability and relatively small memory time, 192 nsec. (auth)

930 ELECTRONICS FOR DRIFT CHAMBERS. Verweij, H. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 437-440 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Signals from sense wires in drift chambers are of muA amplitude and nsec duration. Their time position depends on the drift time and indicates at what distance from the wire the particles passed through the chamber. These times must be measured with accuracies of the order of 2 nsec. A review of circuits and techniques to detect the signals and to measure drift times is given. (auth)

931 OVERCURRENT DETECTOR FOR WIRE CHAMBER HIGH VOLTAGE SUPPLIES. Kerns, C. R. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 441-445(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A high-potential isolated circuit for remotely measuring, monitoring, and crowbarring high-voltage power supplies at a variable preset current threshold level is described. It is presently being used in a high-energy physics experiment utilizing proportional chambers which require self-destruct protection from high-current discharges. An absolute current threshold of one microampere has been achieved. The circuit is not damaged by monentary current overloads of ten amperes or less. (auth)

932 CAMAC MWPC READOUT SYSTEM WITH EVENT SELECTION LOGIC. Buchanan, J. A. (Rice Univ., Houston). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 543-546(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The system to be described is a new and expanded version of a MWPC readout system that has been in use for over four years. Except for the amplifier cards, the new system is implemented entirely in CAMAC modules installed in a dedicated crate. An amplifier card services sixteen MWPC wires, each wire having an amplifier and discriminator with strobed storage into a shift register. The circuit diagram of the amplifier-discriminator is shown. The amplifier stage has an AC gain of 100. The discrimination level is adjusted for all amplifiers in a plane coordinate simultaneously by varying the reference voltage. As many as 32 of the 16 wire amplifier cards plug into the MWPC motherboard along with a driver card to form a plane coordinate. Each plane coordinate is connected to a single-width CAMAC readout (RO) module via a six-pair shielded cable. A double-width CAMAC control module connected to the RO modules by a printed circuit bus board located above the CAMAC dataway controls the conversion sequence. The system configuration is shown. (WHK)

933 FAST ELECTRONICS FOR SCINTILLATION COUNTER SYSTEMS IN SPACE EXPERIMENTS. Arens, I. (European Space Research and Tech. Centre, Noordwijk, Netherlands). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 587-591(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Fast coincidence and analog electronics have been developed to process signals from the scintillation and Cherenkov detectors of the triggering telescope, which forms part of the COS-B experiment for gamma ray astronomy. Design requirements and solutions for the electronics are presented, and the performance is discussed. Integrated circuits have been used extensively in order to minimize the number of components, hence volume and weight, and to optimize the reliability. The goals of a time resolution down to 3 ms for a dynamic range of 1 to 30, a signal processing time of 200 ns for timing and 500 ns for analog analysis, a maximum temperature instability of the trigger thresholds of 2 percent of the typical signal amplitude over a range of 50°C and a maximum non-linearity of 1 percent of full scale for the pulse height analysis have been achieved. (auth)

Radiometric Instruments

Refer also to abstracts 624 and 2130.

934 (AD-777907) DESIGN, DEVELOPMENT, AND TEST OF A ROCKET PAYLOAD TO MEASURE ATMOSPHERIC DENSITY. Final Report, 8 February 1972–15 November 1973. Huber, W. B. (Tri-Con Associates, Inc., Cambridge, Mass. (USA)). Jan 1974. Contract F19628-72-C-0234. 61p. (AFCRL-TR-74-0033). NTIS $3.75.

Rocket-borne instrumentation to measure atmospheric density in the 100 to 200 km altitude region was designed, developed, and fabricated. The instrumentation employed two pulsed 4.5 keV electron beams each with an average current of one milliampere. Observation of the beam-induced bremsstrahlung was made with two end-window proportional counters and associated electronics in the 1.0 to 4.5 keV x-ray region. The ultraviolet fluorescence was observed with a single 3914 Å photometer and associated logarithmic electrometer. In order to measure vehicle charge, a planar retarding potential analyzer was employed. This report details the sensor specifications and electrical design of the instrument payload. (GRA)

935 (ANCR-1201) MATHEMATICAL ANALYSIS OF A TWO-BEAM GAMMA DENSITOMETER. Lassahn, G. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Feb 1975. Contract AT(10-1)-1375. 37p. Dep. NTIS $4.00.

A mathematical analysis was done for a two-beam gamma densitometer used with simple two-phase flow geometries. The ambiguity and errors are discussed for the particular system considered, and data interpretation charts are given. Generally applicable mathematical techniques are outlined, and a pertinent computer program is listed. (auth)

936 (INT-61/I) STREAM RADIOISOTOPE X-RAY FLUORESCENCE ANALYZER AND A METHOD FOR THE DETERMINATION OF COPPER IN SLURRY. Holynska, B.; Lankosz, M.; Lacki, E.; Ostachowicz, J.; Baran, W.; Owsiak, T. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1974. 73p. (In Polish). Dep. NTIS (US Sales Only) $6.75.

The paper presents an "on stream" analyzer and a radioisotope x-ray fluorescence method for the continuous determination of copper content in feed 0.5 to 2.5% Cu, concentrates 15 to 25% Cu and tailings 0.01 to 0.03% Cu. The analyzer consists essentially of a radioisotope x-ray fluorescence measuring head, γ-density gauge, electronic unit, analog processor and recorders. The method is based on the measurement of the characteristic radiation of Cu series, selected by nickel–cobalt filters. The total relative error of the determination of copper in feed is 6 to 8%, in concentrates 5 to 7% and in tailings about 18%. The "on stream" analyzer has been successfully operated in a pilot plant. (auth)

937 (WANL-TME-1747) POSITRON SENSOR OPERATED AS A DENSITOMETER (NON-NERVA). Gibson, G.; Rowland, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1968. 40p. Dep. NTIS $5.00.

A positron source and a detector of annihilation quanta can form a fast response system that senses changes in its environment. Experimental results are presented to demonstrate that such a sensor can be used to measure gas densities. A particular densitometer design has been calibrated for air at room temperature over the pressure range 100 mm-Hg < p < 760 mm-Hg. This pressure range was determined by the limitations of the vacuum chamber used in the calibration. The counting rate has been observed to vary linearly with pressure. Expressions are given for the sensitivity and the statistical uncertainty as a function of source strength, counting interval, and thickness of Be covering the source. Processes and effects that are important in the determination of the count rate as measured by the densitometer are discussed. (auth)

938 DETERMINATION OF MOISTURE CONTENT IN COAL. Schaefer, H. G.; Jansen, H. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Aufbereitung, Kokerei und Brikettierung). Erdoel Kohle, Erdgas, Petrochem.; 27: No. 8, 436-440(Aug 1974). (In German).

The paper deals with the significance of moisture in coal and its measurement. A survey of the methods of measuring the water content is given (γ-absorption and fast neutron attenuation), in which emphasis is given to the indirect ways of real-time measurement. (auth)

939 MOISTURE CONTROL WITH A RADIOACTIVE PROBE. Pels Leusden, C. O.; Reinders, R.; Kalinowski, J. (Institut fuer Ziegelforschung e.V., Essen (F. R. Germany)). Ber. Deut. Keram. Ges.; 52: No. 1, 4-7(Jan 1975). (In German).

From discussion meeting: automatization and continuous measuring in the ceramics industry; Wiesbaden, F. R. Germany (3 Oct 1974).

The first step was to investigate possibilities of compensating for large density variations in moisture content measurements in granular heavy-clay bodies. Then regulation and control equipment was developed for an existing probe and the effectiveness of the system for controlling the moisture content in the feeder was examined. It was found that under the given conditions (and that in spite of a non-uniform moisture distribution in the raw material) the moisture content could be controlled to within ±1% at an early stage of the production line, viz. in the feeder. The remaining small variation is then further reduced during the subsequent mixing processes to such an extent that any final correction of the moisture content, e.g., by plasticity measurements, etc., becomes unnecessary. (auth)

940 ABSOLUTE NEUTRON YIELD OF A FLUORESCENT THYROID SCANNER SOURCE. Robinson, E. L.; Bair, J. K.; Duggan, J. L. (Univ. of Alabama, Birmingham). Health Phys.; 28: No. 3, 205-207(Mar 1975).

Systems for x-ray fluorescent scanning of thyroid glands use the γ-radiation from multicurie ^{241}Am sources to stimulate characteristic x-rays of the iodine in the gland. Nuclear reactions induced in the source matrix by α-particles from the decay of ^{241}Am produce a flux of fast neutrons. The neutron flux of a 5-Ci ^{241}Am source in the source-collimator assembly of a fluorescent scanner was measured to be 3.22×10^4 neutrons/sec with an r.m.s. error of ± 2.2%. (auth)

941 NEW DEVELOPMENTS FOR TESTING THE THICKNESS OF METALLIC COATINGS. Galvano-Organo; No. 450, 1093-1098(Dec 1974). (In French).

New instruments for the measurement of metallic coating thickness were recently developed. Beta backscattering gages for the non-destructive testing of coating thickness and coulometers for the measurement of the anodic dissolution of metallic coatings are presented. The utilization and possibilities of these instruments are given. (FR)

942 A RELAY RADIO-ISOTOPIC DEVICE. Gavrilov, A. P.; Korkonosov, V. P.; Peresypkin, A. V.; Shapovalov, E. P.; Pozdnikov, V. N.; Sazonov, O. L.; Taxar, I. M.; Tesnavs, E. R.; Yanushkovskii, V. A. French Patent 2,197,496/D/. 28 Aug 1972. 16p. (In French).

The apparatus consists of a detector unit for receiving ionizing radiation and to transform it into electric pulses and a relay electronic unit. This unit contains a discontinuous comparator, a relay element, and a predeterminator of threshold frequencies of the regular sequence of electric pulses. One of the inputs of the comparator is connected to the detector unit and delivers a statistical sequence of electric pulses. The other input is connected to the predeterminator. The output of the comparator is coupled to the relay element whose outputs are connected to two inputs of the predeterminator. The latter is characterized by two frequency thresholds. It is applicable to the control and automation of technological processes in various branches of industry, transports, and agriculture. (tr-auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 827 and 2445.

943 (AD-780999) INVESTIGATION OF POSSIBILITIES FOR IMPROVEMENT IN STABILITY OF PHOTOELECTRIC CHARACTERISTICS OF IRRADIATED SILICON P–N JUNCTIONS. Grigoreva, G. M. 10 Jan 1973. Translated from pp 167-173 of Nauka i Tekhnika (USSR), 1970. (FSTC-HT-23-1436-72). 10p. NTIS $4.00.

Methods are considered for increasing the stability of photoconverters operating in the conditions of hard radiation action. One of the methods in question is thermal annealing of the irradiated devices. A change is considered in the process of annealing of the spectral distribution of photosensitivity and the diffusion length of the minority carriers in the base of irradiated n-p type photoconverters. Another possibility for assuring radiation resistance is doping them with lithium. The results are presented of irradiation and low-temperature annealing of p-n type photoconverters with an impurity of lithium and various concentrations of oxygen. In the case when the content of oxygen in silicon is small (10^{17}/cc) devices with an impurity of lithium reveal an extremely high resistance to irradiation. The ability of lithium to neutralize recombination centers in silicon having a nonradiation origin is also shown. (auth)

944 (AD/A-000833) CHARGE TRANSPORT AND POLARIZATION EFFECTS IN DIELECTRICS OF MSI/LSI DEVICES. Final Report, February 1972–July 1974. Leadon, R. E.; Snowden, D. P. (Nuclear Battery Co., Columbia, Md. (USA)). Sep 1974. 58p. (RT-8046-002). NTIS $4.25.

The purpose of the program was to investigate the magnitude and characteristics of the charge transfer and polarization that occur during an ionization pulse in typical oxide dielectrics used in MSI/LSI devices, especially those used for passivation and separation of multilevel metalizations. (GRA)

945 (AD/A-001705) DCA HEMP HARDNESS-CERTIFICATION METHODOLOGY: STATUS. Final Report, July 1972–February 1974. Whitson, A. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). Feb 1974. Contract DCA100-72-C-0042. 19p. NTIS $3.25.

The Defense Communication Agency is developing a methodology to HEMP hardness assess the defense communication system. The methodology program has just completed the first phase of development with completion of threshold testing of an AECO Autovon switch at Roscommon, Michigan, and temps testing of an Autovon switch center at Polk City, Florida. This summary reviews the status of the methodology development by reviewing the assumptions and techniques used to date in the development. (GRA)

946 (AFCRL-TR-73-0682) BEHAVIOR OF INJECTION LOCKED IMPATT AND FREE RUNGIN TRAPATT OSCILLATORS UNDER TRANSIENT IONIZING RADIATION. Final Scientific Report, 1 December 1971–30 June 1973. Ghandhi, S. K.; Borrego, J. M.; Gutmann, R. J.; Geipel, H. J. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1 Nov 1973. Contract F 19628-72-C-0112. 38p. NTIS.

X-band injection locked IMPATT oscillators were exposed to 100 nanosecond pulses of 10 MeV electrons at dose rates between 3×10^8 and 3×10^9 rads/sec. During the radiation pulse, the rf power of the oscillator was found to be independent of the locking signal while the rf frequency shift depended upon the power of the locking signal. Original performance was regained within a few rf cycles following the radiation pulse. S-band TRAPATT diode pulsed oscillators were exposed to 100 nanoseconds pulses of 10 MeV electrons at dose rates between 2×10^7 and 4×10^8 rad/sec in both evacuated and air-filled cavities. The rf power is unaffected below a critical dose rate, which is typically between 8×10^7 and 2×10^8 rads/sec. Above this critical dose rate the rf power is almost quenched entirely during the radiation pulse, but recovers to the original level within 50 nanoseconds afterwards for all dose rates used. Rapid recovery of original rf power levels occurred when the radiation pulse occurred at the initiation of the 300 nanosecond rf TRAPATT pulse, in the middle of the TRAPATT pulse, or during the decay of the TRAPATT pulse. (auth)

947 (EGG-1183-1532) EFFECTS OF RADIATION ON PHOTOGRAPHIC FILM. A Study. Dutton, D. M. (EG and G, Inc., Las Vegas, Nev. (USA)). 15 Oct 1971. 106p. Dep. NTIS $8.50.

This study of the effects of radiation on photographic film is related to the Nevada Test Site's underground nuclear testing program, which has been active since implementation of the Limited Test Ban Treaty of 1963. Residual radioactivity, which has accidentally been released on several tests, adversely affects the photographic film used in test data acquisition. The report defines this problem in terms of radiation-caused image degradation, radiation/matter interactions, types of radiation released by accidental venting, and the photographic effects of gamma and x-radiation. Techniques and experimental findings are documented that may be useful in recovering information from radiation-fogged film. Techniques discussed include processing methods, shielding, image enhancement techniques, and operational handling of potentially irradiated film. (auth)

948 (FZK-351-1) NERVA IRRADIATION PROGRAM. GTR Test 21. Volume I. Evaluation of a Polarographic Hydrogen-Gas Detector. Irby, G. E.; Carter, H. G.; Lewis, J. H. (General Dynamics/Fort Worth, Tex. (USA)). 15 Dec 1967. 66p. Dep. NTIS $6.50.

The performance of a Beckman polarographic hydrogen-gas detector when exposed to a reactor radiation field has been evaluated. The test was performed at the Nuclear Aerospace Research Facility (NARF) on 8 September 1967 by irradiating a sensor with the Ground Test Reactor (GTR) at several power levels up to 4.35 MW. Gases with known percentages of hydrogen were used to determine the instrument performance as a function of reactor power level. (auth)

949 (ONERA-NT-200) INFLUENCE OF SPACE RADIATIONS ON THE CACTUS ULTRASENSITIVE ACCELEROMETER. Tiffon, J. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France)). 1972. 54p. (In French). INIS.

During the orbital flight of the D5-B satellite, made by C.N.E.S. (the French Space Agency), devoted to the qualification of the CACTUS ultrasensitive accelerometer made by O.N.E.R.A., the electric charge gathered by the proof mass of this accelerometer under the influence of high energy radiations may perturb the operation of this instrument. A bibliographic study shows that this charge effect is mainly due to the protons and electrons of the Van Allen belts through which the D5-B satellite will fly. The various characteristics of the proton and electron interaction process with the matter lead to the separate study of the influence of these two kinds of particles on the level of the mass electric charge. Periodic discharges of this mass by contact are being considered. These results permit determination of the frequency of these discharges. (INIS).

950 (RN-S-0251) RESISTANCE TEMPERATURE TRANSDUCER IRRADIATION PROGRAM, SUMMARY REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 124p. Dep. NTIS $9.25.

This report summarizes the results of three radiation effects tests on resistance temperature transducers: Test 23/L101, GTR-12A, April 1964; Test 23/L102, GTR-14, July 1964; and Test 23/R103, GTR-15, December 1964. A total of 18 RTT's of 6 different models (Rosemount 134EB250, Rosemount 134EB1X, Rosemount 134EB2X, Rosemount 134GT, Rosemount 110AA150, and Winsco 2448-5) were irradiated in LH_2; however, 2 units were irradiated in all tests and accumulated a fast neutron exposure of 2.2×10^{17} nvt (E > 1.0 Mev) while being maintained at −423°F. Since the units were irradiated under the same environment, the data are analyzed collectively. The results of these tests followed closely the predicted performance with respect to temperature measurement errors (2°F to 8°F). Although several transducer circuits experienced open circuits, none of the transducers themselves experienced mechanical or electrical failure from radiation. (auth)

951 (TID/SNA-1170) DESIGN AND DEVELOPMENT OF EXPERIMENTAL SYSTEM AMPLIFIERS SYSTEM PACKAGES, SERIAL NUMBERS 4, 5, AND 7. Howard, D. W. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). Oct 1963. 106p. Dep. NTIS $8.50.

For Aerojet-General Corp., Azusa, CA.

The design, development, and testing of the amplifier assemblies which regulate the thrust of the NERVA engine by controlling the critical parameters of chamber pressure and temperature are described. Tests include extreme temperature, radiation effects, and vibration tests. Results are presented and discussed. (WHK)

952 (TID/SNA-1215) DESIGN OF NUCLEAR-RADIATION-EFFECTS EXPERIMENTS. Drennan, J. E.; Cote, R. W.; Hamman, D. J. (Battelle Columbus Labs., Ohio (USA)). 15 Aug 1967. 93p. Dep. NTIS $7.75.

Effective use of known experimental design principles in planning nuclear-radiation-effects experiments associated with engineering development programs assures that necessary, useful information will be obtained from the characteristically costly and time consuming radiation-effects tests. This report discusses the principles of experimental design and illustrates their compatibility with nuclear-radiation-effects experimentation by presenting a model experimental design for a hypothetical nuclear-radiation-effects experiment. Details of an analysis procedure

that uses linear regression techniques are illustrated by numerical example. Although the model experiment design is directed toward specific problems and a specific instrument, its format and logic are applicable generally to nuclear-radiation-effects experimentation. It is believed that the data-reduction and analysis procedures documented in this report may be applicable in detail to a wide variety of nuclear-radiation-effects experiments that may be planned in support of system-development programs. (auth)

953 (TID/SNA-1277) PERFORMANCE REPORT OF BREADBOARD SYSTEM AMPLIFIER PACKAGE, S/N 2. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). Sep 1963. 43p. Dep. NTIS $5.25.

For Aerojet-General Corp., Azusa, CA.

The electrical circuit and theory of operation for each of the four system amplifiers is contained in Section V of Report No. BPAD-863-4-15076 entitled "Design and Development of Breadboard System Amplifier, S/N 1 System Package." The modifications included in the design and fabrication of the second breadboard package to upgrade the amplifiers to the radiation tolerant configuration are described. Four major modifications have been included in the S/N 2 breadboard package, they are: (1) substitution of the radiation tolerant UG-59 diode for the 1N485B conventional silicon device; (2) the replacement of the standard AN-3102-22-19P receptacle with a radiation tolerant Deutsch Type MDROO-540-19P receptacle; (3) inclusion of copper-constantan thermocouples in and on the various amplifier components for determination of gamma heating effects; and replacement of the gain and rate potentiometers with selected wire-wound resistors. (auth)

954 (TID/SNA-1650) PRELIMINARY CANDIDATE LIST FOR PREFERRED PARTS, RIFT STAGE. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA). Space Programs Div.). 15 Dec 1962. 16p. Dep. NTIS $4.00.

Preliminary candidate lists of capacitors and resistors for use in early RIFT design work and notes of radiation effects on capacitors and resistors are presented. (LCL)

955 (WANL-TME-250) PRELIMINARY RESULTS OF EXPERIMENTS 11 THROUGH 17 CONDUCTED AT THE WESTERN NEW YORK NUCLEAR RESEARCH CENTER REACTOR DURING THE TIME PERIOD DECEMBER 17 THROUGH DECEMBER 21, 1962. Kalapaca, H. P. (comp. and ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Jan 1963. 19p. Dep. NTIS $4.00.

Tests performed to determine the radiation effects of a fast neutron flux of 1.2×10^{12} n/cm^2-sec and a thermal neutron flux of 3.9×10^{12} n/cm^2-sec on electrical and electronic equipment, e.g., amplifiers, cables, neutron detectors, connectors, and diodes, for the NERVA program are described and the results are presented. (LCL)

956 (WANL-TME-1944) FLASH X-RAY TESTING OF INTEGRATED CIRCUIT. Dottle, H.; Ferber, R. R.; Kalapaca, H. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Aug 1969. 16p. Dep. NTIS $4.00.

A series of flash x-ray tests on integrated circuits were conducted at Westinghouse Astronuclear Laboratory's flash x-ray facility. The purpose of the test program was to investigate transient x-ray effects on sense amplifier (MC1440G) and read-write register (S8828A) integrated circuits associated with magnetic core memory systems. Although some experimental test data were available on these specific integrated circuits, the ionizing radiation transient response of these devices was unknown. The integrated circuits were subjected to a flux of 10^6 R/sec to 5×10^9 R/sec. The duration of the induced photo voltage pulses was approximately 2 milliseconds and increased with increasing radiation rate. Radiation levels from 10^6 R/sec to 5×10^6 R/sec did not alter the read-write register operation; however, at a level of 10^9 R/sec, the circuit operation became erratic for periods up to 100 μ sec. No latch-up or permanent damage was noted after exposure to levels of 5×10^9 R/sec. (auth)

957 IMPROVED MODEL FOR PREDICTING SPACE PERFORMANCE OF SOLAR CELLS. Horne, W. E.; Wilkinson, M. C. (Boeing Aerospace Co., Seattle). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 130-137(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The radiation degradation produced in solar cells by the energetic charged particles of space is an important design constraint for many space missions. Since the original degradation estimates for Telstar by Brown and Rosenweig, a series of reports sponsored by NASA have reflected the development of increased environment definition and solar cell degradation understanding. These reports have treated the degradation of the solar cell primarily by bulk displacement damage through the use of an experimentally determined damage coefficient. This paper discusses an improvement over previous methods in that 1) a more detailed accounting is made regarding the effects of isotropically incident spectra or the effect of shielding, 2) a more detailed accounting is made regarding low energy proton damage, 3) the entire I-V characteristic is calculated, and 4) annealing in lithium cells can be accounted for. (WHK)

958 DAMAGE COEFFICIENT AND DEFECT LEVEL OF COPPER-CONTAMINATED SILICON N^+P DIODE. Usami, A.; Kato, Y. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 820-824(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The damage coefficient at 298^{0}K of copper-contaminated N^+P diodes is smaller than that of non-contaminated ones. In these copper-contaminated samples, the higher the bulk resistivity is, the smaller is the damage coefficient. For non-contaminated diodes, the damage coefficient of samples of pulled bulk crystals is smaller than that of floating zone crystals, and the higher bulk resistivity diodes have smaller damage coefficient. At 217^{0}K measurement, the effect of copper-contamination on the damage coefficient could not be observed. The energy levels of defects introduced by gamma ray irradiation are approximately 0.30 eV, and approximately 0.28 eV with non-contaminated FZ 135 ohm-cm and CZ 10 ohm-cm bulk samples, respectively. In copper-contaminated samples, approximately 0.60 eV and approximately 0.45 eV are obtained as the defect energy levels for FZ 135 ohm-cm and CZ 10 ohm-cm bulk samples. (auth)

959 RADIATION EFFECTS ON GaAsP LIGHT-EMITTING DIODES AND SCHOTTKY BARRIER FIELD-EFFECT TRANSISTORS. Pancholy, R. K. Albuquerque, NM; Univ. of New Mexico (1974). 256p. University Microfilms Order No. 75-5882.

Thesis (Ph. D.).

New processes developed for the fabrication of gallium-arsenide-phosphide light-emitting diodes and Schottky barrier field-effect transistors are described. The fabricated devices were characterized electrically and were tested in a radiation environment. Transient effects on p-n junction diodes due to high energy electron beams were examined and the permanent damage caused by high energy neutrons on both diodes and SBFETs were evaluated. (WHK)

Miscellaneous Instruments

Refer also to abstracts 382, 616, 994, 1574, 1575, and 1923.

960 (AERE-R-7867) INSTRUMENTATION SYSTEMS USING MODULAR UNIT FACILITIES. Seymour, F. D.; Snelling, G. F.; Hawthorn, I. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1975. 26p. Dep. NTIS (US Sales Only) $4.50. UK 50 pence.

Considerable use has been made of facilities that conform to modular unit schemes in providing nucleonic and other types of instrumentation for the UKAEA and external organizations. The Harwell 2000 and 7000 Series schemes are well-known and established in the wide spectrum of instrumentation requirements. This report illustrates how the latest scheme, the Harwell 6000 Series, has been used recently to achieve contemporary instrumentation systems for applications in x-ray diffraction, process instrumentation and data logging. Examples of environmental gamma-monitoring and gamma-spectrometry are included and an abridged list is given of systems developed so far, to illustrate the variety and range of instrumentation that can be achieved. (auth)

961 (COO-3158-40) SIMPLIFIED METHOD FOR THE CALIBRATION OF AN ATOM-PROBE FIELD-ION MICROSCOPE. Report No. 2392. Wagner, A.; Hall, T. M.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Feb 1975. Contract AT(11-1)-3158. 7p. Dep. NTIS $4.00.

A simplified method for the calibration of a time-of-flight (TOF) atom-probe field-ion microscope (FIM) is reported. The ingenious TOF atom-probe FIM which was invented by Müller, Panitz and McLane is capable of determining the mass-to-charge ratio (m/n) of individual atoms which have been pulse-field evaporated from the surface of an FIM specimen. The basic relationship used to calibrate the TOF atom-probe FIM is obtained by equating the kinetic energy of an ion to its potential energy. (WHK)

962 (JINR-P13-8324) FAST COINCIDENCE CIRCUIT OF 1 ns RESOLUTION. Boreiko, V. F.; Zinov, V. G. (Joint Inst.

for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A coincidence circuit with the minimal resolution of 1 ns and the speed of response of 100 MHz is described. Each channel has an electron delay allowing smooth variation of the fine position of the pulses by 2 ns. (auth)

963 (ORNL-TM-4862) TEMPERATURE MEASUREMENT ERRORS WITH TYPE K (CHROMEL VS ALUMEL) THERMOCOUPLES DUE TO SHORT-RANGED ORDERING IN CHROMEL. Kollie, T. G.; Carr, K. R.; Horton, J. L.; Herskovitz, M. B.; Mossman, C. A. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 57p. AT.

After annealed, type K (Chromel vs Alumel) thermocouples were heated above 200°C, their temperature measurements were in error up to 1.7%, as determined by comparison calibrations to working standard 90% Pt-10% Rh vs Pt thermocouples or platinum resistance thermometers. Reannealing the type K thermocouples removed the errors. The errors were due to changes in the thermal emf vs temperature relationship of the type K thermocouples, which from previous work of others can be attributed to short-ranged ordering of the Chromel thermoelements. Reannealing the thermocouples removed the errors because the order-disorder transformation is reversible; that is, short-ranged ordering of the Ni and Cr atoms of the Chromel alloy occurs between 200 and 600°C and disordering occurs above 600°C. The traveling gradient method was used to determine the effects of heat treatment on the thermal emf of type K thermocouples, to investigate the kinetics of ordering of Chromel, and to determine the amount of order produced by heat treatments. Though the order-disorder transformation could not be stopped, our results demonstrate that there exists an optimum amount of order in the Chromel thermoelement to yield a repeatable thermal emf vs temperature relationship for a type K thermocouple in a specific application. When the experimental conditions of the application were controlled carefully, heat treatment to produce the optimum order in the Chromel thermoelements and calibration of the type K thermocouples prior to use essentially eliminated the temperature measurement errors due to order. The optimum amount of order depended on the application and was determined experimentally. Variations from the optimized heating or cooling cycles, changes in the depth of thermocouple immersion during use, or modification of the temperature gradient on the thermocouple caused temperature measurement errors of up to 1% with ordered and calibrated type K thermocouples. (auth)

964 (RN-TM-0300) FEASIBILITY REPORT FOR A METHOD OF PIEZOELECTRIC ACCELEROMETER TEMPERATURE COMPENSATION. Kneeland, D. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Jan 1966. 13p. Dep. NTIS $4.00.

The charge sensitivity of lead zirconate–lead titanate peizoelectric transducers varies considerably with temperature. The possibility of using a ceramic element capacitance measurement as an indication of the relative change in charge sensitivity due to temperature variations was investigated. This type of measurement will enable data users to correct for temperature effects, thereby increasing the overall system accuracy. (WHK)

965 (RT/CHI-(74)7) TDR METHOD AND APPARATUS FOR MEASUREMENT OF LEVELS AND PHYSICAL CHARACTERISTICS OF MOVING OR STATIC LIQUIDS AND FLUIDS IN PIPELINES OR TANKS. De Carolis, M.; Bardone, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1974. 82p. Dep. NTIS (US Sales Only) $7.50.

A new method and apparatus for measuring liquid or fluid levels in dynamic or static conditions in pipelines or tanks is described. Based on the time domain reflectometry technique, the system works like a closed circuit radar, revealing any mismatch along a transmission line. It uses traditional instrumentation for high-frequency reflectometry measurement (12.4 GHz), associated to a special stainless steel probe. Besides levels, the system can give the volume and information about some physical characteristics of the liquid or liquids under examination, such as dielectric constant, dispersion and emulsion states. Because of its independence from physical characteristics and conditions of the liquid (e.g., density, viscosity, temperature, etc.) and for good accuracy, precision and reliability of the measuring head it can substitute successfully systems and methods currently used for level measurements. Installation tests and performances in the laboratory and in a nuclear fuel reprocessing plant are described. The detection limit is about ±2 mm. The system can be considered tamperproof for nuclear safeguard purposes. (auth)

966 (SGAE-2348) CAMAC: 24-BIT OUTPUT REGISTER COP-3 AND EFFECTIVE-NOMINAL VALUE COMPARATOR. Schwabach, H.; Vogl, G.; Koutny, P.; Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Sep 1974. 16p. (In German). (EL-34/74). Dep. NTIS (US Sales Only) $4.00.

Two CAMAC modules, a modulator output register with a power limited output stage and a comparator, are described. (auth)

967 (SGAE-2389) ANALYTIC FUNCTIONS FOR THE TEMPERATURE DEPENDING ON THE THERMOVOLTAGE DUE TO CALIBRATION TABLES. Weiser, O. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Reaktortechnik). Nov 1974. 34p. (In German). (RT-81/74). Dep. NTIS (US Sales Only) $4.75.

Analytic functions are presented for NiCr/Ni and Cu/Const thermocouples which represent the dependence of the temperature from the thermoelectric voltage due to the reference tables for thermocouples from the National Bureau of Standards, so data can be processed directly by minicomputers. The temperature of the thermostat with the reference junction need not be kept at a constant value but that temperature enters the calculation. Resistivity thermometers Pt-100 are treated also. (auth)

968 (TID/SNA-1455) DYNAMIC CALIBRATION STUDY. Copen, W. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Oct 1963. 116p. Dep. NTIS $9.00.

Since transducers used in rocket engine applications measure time varying quantities, the characteristics which define the behavior of a transducer under dynamic conditions are extremely important in their applications by the design engineer. Proper calibration of transducers in the dynamic or frequency domain required a thorough understanding of the dynamic characteristics of a transducer. Analytical models are generated, and the techniques based on these models for determining frequency response are discussed. The effects of the system elements, such as tubing and ports, on dynamic characteristics in addition to the effect of the measured environment itself are examined. Analog and digital techniques to compensate system performance for the improvement of frequency response are presented. Additional considerations in system design are discussed, especially the effect of a sampled data acquisition system. The special problems of temperature sensor dynamic characteristics are covered in detail. Finally, experimental methods for determining transducer dynamic characteristics and recommendations for test facilities are given. (auth)

969 (TID/SNA-1498) CALIBRATION SYSTEM FOR CRYOGENIC TEMPERATURE TRANSDUCERS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Sep 1964. 25p. Dep. NTIS $4.25.

To provide the NERVA test program with a temperature measurement system of sufficient accuracy to satisfy present and future requirements, a cryogenic temperature measuring system was designed and developed employing a platinum resistance thermometer (RTT) as the sensor. This system will be used, for example, to measure the liquid hydrogen pump inlet temperatures which determine the vapor pressure head for calculation of NPSH. Five feet of pump vapor pressure head is represented by a liquid hydrogen temperature change of 0.054°F. In order to establish an adequate design for the NPSH parameter, a temperature measurement accuracy of at least ±0.050°F (0.028°K) is considered necessary. This system will be used in other areas of the NERVA propellant feed system and the thrust chamber assembly where cryogenic temperatures must be accurately determined. The gaseous helium cooled cryostat used for precision platinum RTT calibration located in the measurement standards laboratory was designed for operation from room temperature down to liquid helium temperatures. It is capable of calibrating one NERVA RTT at a time since its intended purposes were developmental testing of cryogenic sensors and calibration of standard type platinum resistance temperature standards (capsule type). This cryostat is about ±0.03°F accurate. (WHK)

970 (WANL-TMI-998) METHODS OF DETECTING PARTIALLY ADHERED STRAIN GAGES. Kalning, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1964. 7p. Dep. NTIS $4.00.

An investigation was made at the request of the reactor mechanical design department for the purpose of establishing a means to differentiate between strain gages which are totally bonded and those which have adhered only in part. The reactor mechanical design department suggested that if a 100% bonded strain gage was subjected to a change of temperature it would exhibit a different initial slope and final value of apparent strain than a strain gage which was only partially bonded. All of the

tests that were performed were based on the above assumption. Procedures and results are discussed. (auth)

971 (WANL-TMI-1482) APPARENT STRAIN TESTS CONDUCTED ON MICRODOT WELDABLE STRAIN GAGES. Kaining, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Jun 1965. 8p. Dep. NTIS $4.00.

The results of apparent strain tests conducted on both temperature-compensated and uncompensated Microdot weldable strain gages are reported. The purpose of the test was to establish repeatability and absolute apparent strain values for a temperature range of –320°F to +80°F for the gages. (auth)

972 (WANL-TMI-1596) AFTER INSTALLATION DISPLACEMENT MEASUREMENTS FOR LINEAR VARIABLE DISPLACEMENT TRANSDUCERS. Chambers, G. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jan 1966. 5p. Dep. NTIS $4.00.

The procedure to be used in performing displacement measurements on the core support plate-mounted linear variable displacement transducers (LVDT) after installation is specified. (LCL)

973 FAST ADC. Arbel, A.; Kurz, R. (Zentrallabor fuer Elektronik, Juelich, Ger.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 446-451(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A novel ADC is described, consisting in its simplest and fastest version of a parallel ADC supplying the most significant bits, plus several suitably-connected difference amplifiers in which the input signal undergoes successive folding. Their common output is fed into another parallel ADC which supplies the least significant bits. The conversion rate is of the order of 400 MHz for eight bits. Several versions are described, yielding different trade-offs between speed and the number of discriminators employed. (auth)

974 RESOLUTION AND COUNT RATE CHARACTERISTICS OF THE GATED INTEGRATOR NUCLEAR AMPLIFIER. Karlovac, N. (ORTEC, Inc., Oak Ridge, TN); Blalock, T. V. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 452-456(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A nuclear pulse amplifier using a time-variant filter with a trapezoidal weighting function was theoretically analyzed for optimum performance in a high count rate environment. Analytical tools were developed for the complete characterization of the noise performance of the amplifier. The amplifier was implemented and experimentally evaluated at high count rates. The ^{22}Na line had a peak shift and line broadening no more than 1 part per 1000 when the count rate was varied from a low rate of 5000 cps to a very high rate at 150,000 cps. (auth)

975 TRANSACTION PROCESSING IN THE COMMON NODE OF A DISTRIBUTED FUNCTION LABORATORY COMPUTER SYSTEM. Stubblefield, F. W.; Dimmler, D. G. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 473-479 (Feb 1975).

From 21th nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A computer network architecture consisting of a common node processor for managing peripherals and files and a number of private node processors for laboratory experiment control is briefly reviewed. Central to the problem of private node-common node communication is the concept of a transaction. The collection of procedures and the data structure associated with a transaction are described. The common node properties assigned to a transaction and procedures required for its complete processing are discussed. (auth)

976 LOCALIZED PROCESSING POWER FOR CAMAC SYSTEMS. Iselin, F.; Loefstedt, B.; Ponting, P. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 484-487(Feb 1975).

From 21th nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Implantation of localized processors in a system can often enhance the efficacy of CAMAC. This paper presents some typical localized processors and gives as indication of how appropriate positioning within a CAMAC system can minimize the effect of some of the restrictive characteristics of source data and system configuration. (auth)

977 CONFUSING DIGITAL STANDARDS PICTURE: ARE THEY RELATED. Horelick, D. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 488-493(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Due to the realization of international competition and the recognition that perhaps the time for action has arrived, there recently has been a flurry of activity in many areas of digital interfacing standards. This paper reviews the status and discusses the relation of the CAMAC system, the IEC bus, the channel interface, and the new bit serial standards in terms of the nuclear instrument, process control, and general computation communities. (auth)

978 CAMAC SERIAL HIGHWAY UTILIZING A LASER LINK. Scaief, C. C. III; Troyer, G. L. (Atlantic Richfield Hanford Co., Richland, WA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 499-501 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A system for extending a CAMAC serial highway to a distance of 2 kilometers using an optical link is described. The system utilizes commercially available laser transceivers operating in the pulse mode. Information is transmitted asynchronously and then resynchronized at the receiver interface. The serial highway extension provides effective remote instrument control and interprocessor communication for routine laboratory analyses and process support. (auth)

979 DIGITAL INSTRUMENTATION NODE: AN ALTERNATIVE TO CAMAC. Marple, M. J.; Culvahouse, J. W. (Univ. of Kansas, Lawrence). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 502-507(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

During the development of a computer network for diverse real-time applications in physics and chemistry, a system was designed and developed to provide interfacing of instruments to each other as well as to a computer, and also to facilitate utilization of advanced solid state electronics in custom instruments. The result is a well-documented interfacing system with features and capabilities which are of growing importance in scientific and process instrumentation. This paper focuses attention on the distinctive features of the new system, features which are not usually available in CAMAC. These include the use of decentralized control, the addressing scheme, the monitor and control capabilities, the fast cycle time, and the simplicity of using the system. (auth)

980 CAMAC CRATE CONTROLLER USING A MICROPROCESSOR. Bobbitt, J. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 508-510(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

An inexpensive CAMAC system has been developed around a microprocessor. This system may be used as a stand-alone system or as a subsystem in a distributed processor system. It incorporates both CAMAC modules and non-CAMAC devices. (auth)

981 SIMPLE, VERSATILE CAMAC CRATE CONTROLLER AND INTERRUPT PRIORITY ENCODING MODULE. Horelick, D. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 517-520(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A simple, versatile crate controller has been in use in CAMAC installations at SLAC for several years. Its design is based upon the criteria of minimum circuitry to connect seven CAMAC crates together on a "SLAC branch". A priority encoding module to rapidly identify interrupt sources has been designed to work in conjunction with this crate controller for high rate interrupt environments. The concept is applicable to the standard branch as well. (auth)

982 CAMAC AND NIM SYSTEMS IN THE SPACE PROGRAM. Trainor, J. H.; Ehrmann, C. H.; Kaminski, T. J. (Goddard Space Flight Center, Greenbelt, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 521-525(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Electronics systems for space missions have often been highly constrained by weight and power as well as performance. This led to highly customized designs for most missions. With the advent of the Shuttle launch vehicle and spacecraft, and the Spacelab concept in the late 1970's, it will be possible to fly payloads of several very large experiments for periods of 7 to 30 days. For such experiments weighing several thousand Kg, approximately 100 Kg of supporting electronics is quite acceptable and this weight is adequate to accomplish the design in NIM and CAMAC for a large variety of experiments. Power consumption is a problem both from the point of view of sizing of the fuel cells and thermal consequences. Several studies are now underway on reducing this power consumption and the outlook is promising. The motivation for the usage of NIM and CAMAC on Shuttle is not only convenient to the experimenter, but a substantial cost savings originally, and still more in the future as the modules are reconfigured for yet another experiment. (auth)

983 CAMAC AT AERE HARWELL. Barnes, R. C. M. (Atomic Energy Research Establishment, Harwell, Eng.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 526-528(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Much pioneering work in CAMAC has been done at Harwell, leading to one of the first comprehensive ranges of CAMAC equipment. Features of particular interest are inter-crate highways, flexible autonomous transfers, and programmed controllers for computer-less systems. These features are used in the systems described. (auth)

984 MEGACHANNEL PULSE HEIGHT ANALYZER BASED ON A MAGNETIC DRUM WITH CAMAC INSTRUMENTATION. Tenten, W.; Reinhart, P.; Mueller, K. D. (Zentrallabor fuer Elektronik, Juelich, Ger.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 529-531(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A pulse height analyzer with 1,048,576 channels has been developed, using a magnetic drum as storage device. CAMAC instrumentation including a special purpose drum controller is used for interfacing to a PDP-11 computer. By combination of hardware and software techniques a data rate of 10^4 events per second is achieved. (auth)

985 STANDARDIZED EQUIPMENT FOR SPACE SHUTTLE EXPERIMENT PAYLOADS. More, K. A.; Ebert, D. (Bendix Aerospace Systems Div., Ann Arbor, MI). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 582-586(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

NIM and CAMAC standards were evaluated for use in Space Shuttle experiment payloads. Six payloads were studied and it was found that 30 to 90 percent of the electronic functions could be performed with standard, commercially available modules. Only minor modifications are required to adapt the standards to the Shuttle requirements. (auth)

986 INSTRUMENTATION FOR ENVIRONMENTAL MONITORING IN BIOLOGICAL SYSTEMS. Amer, N. M.; Graven, R. M.; Budnitz, R. J.; Mack, D. A. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 633-635(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A brief review of the status of instrumentation for monitoring environmental pollutants is given. Pollutants are divided into six broad categories: trace elements, pesticides and herbicides, ionizing radiation and radionuclides, asbestos and other microparticulates, and gaseous pollutants. (WHK)

987 CORRECTION OF THIRD-ORDER ANGULAR ABERRATION IN A SYSTEM WITH TWO ELECTROSTATIC MIRRORS. Zashkvara, V. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 7, 961-962(Jan 1975).

Translated from Zh. Tekh. Fiz.; 44: No. 7, 1541-1543(Jul 1974).

The ion-optical configuration of a two-stage electrostatic energy analyzer is discussed. The analyzer consists of two electrostatic electron mirrors, one hyperbolic and one cylindrical, matched in such a way that the total spherical aberration of the system in the direction of the dispersion is proportional to the fourth power of the divergence half-angle in the plane of the axial trajectory. (auth)

988 PRECISE POSITIONING FOR PHYSICS EXPERIMENTS USING NEUTRON BEAMS. CARINE System. Falaise, J.-C. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). Automatisme; 19: No. 8, 414-420(Aug 1974). (In French).

CARINE system (Computer Aid Research in Neutron Experiment) is an electronic system built with two processing computers (T 2000) which work in real time. Each computer is connected to 6 experiments of neutron spectrometry or diffraction. These experiments are situated near a high flux reactor of the Max Von Laue, Paul-Langevin Institut in Grenoble. Hardware parts are described: command of stepping and d.c. motor, reading of shaft encoder, measurements and CAMAC interface. (FR)

989 A DEVICE FOR COLLIMATING AND FILTERING NEUTRON BEAMS. Houelle, M.; Morel, D.; Revol, H. (to CEA). French Patent 2,203,342/A/. 11 Oct 1972. 7p. (In French).

Description is given of a device for collimating and filtering neutron beams emitted by a neutron and gamma generator. This device comprises a collimator mounted in tangential relation to the neutron and gamma source, said collimator being internally coated with a neutron absorbing material, with the exception of that of the extremities thereof which is located in the portion of maximum thermal neutron flux, a reflector acting as gamma screen mounted between said extremity and the neutron and gamma source, and a gamma filtering screen having a low absorption power as regards neutrons, located within said collimator in the vicinity of the other extremity thereof. The device has application at small size nuclear reactors. (FR)

990 TEMPERATURE MEASUREMENT DEVICE. Oltman, B. G.; Eckerman, K. F.; Romberg, G. P.; Prepejchal, W. (to United States Energy Research and Development Administration). US Patent 3,869,918. 11 Mar 1975. Filed date 1 Aug 1973. 4p.

Thermoluminescent dosimeter (TLD) material is exposed to a known amount of radiation and then exposed to the environment where temperature measurements are to be taken. After a predetermined time period, the TLD material is read in a known manner to determine the amount of radiation energy remaining in the TLD material. The difference between the energy originally stored by irradiation and that remaining after exposure to the temperature of the environment is a measure of the average temperature of the environment during the exposure. (Official Gazette)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 2167 and 2317.

991 (AD/A-002439) ISOTOPE SEPARATION USING MAGNETOPLASMA INSTABILITIES. Final Report. Book, D. L. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 28p. (NRL-MR-2908). NTIS $3.75.

The report briefly describes a design for a continuously operating device which separates one isotopic species of a given element from a mixture. The essential innovation is the use of collisionless plasma instabilities to slow down ions of the desired species from two counter-streaming, initially neutral beams. The relevant processes of excitation, ionization and decay occurring in the laser-irradiated atomic beam are discussed. The plasma instabilities and the "braking" process in two symmetric counterstreaming beams are analyzed. Also included are a schematic of a plant design and estimated rates and power requirements. (GRA)

992 (INIS-mf-1681) AN INVESTIGATION OF CHEMICAL PROBLEMS ASSOCIATED WITH THE g.s. PROCESS FOR HEAVY WATER PRODUCTION. Annual Report of Work Carried out under Atomic Energy of Canada Ltd. Contract No. 1851. Thorpe, J. W.; Leffek, K. T. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Dept. of Chemistry). Aug 1972. 83p. INIS.

The following topics are discussed: radioactive tracer experiments, reactions of H_2S with organics present in natural waters, the carbon adsorption method for the isolation of organics from natural waters, examination of the fractions from the carbon chloroform extract, analysis of Landric Lake water for lignin, detergents, and resin acids, examination of plant water samples by U. V. spectroscopy and TOC analysis, physical-chemical methods for removing organics from natural waters, foaming properties of various solutions, analysis for coagulant aid, and future areas of investigation. (auth)

993 (INIS-mf-1682) AN INVESTIGATION OF CHEMICAL PROBLEMS ASSOCIATED WITH THE g.s. PROCESS FOR HEAVY WATER PRODUCTION. Annual Report of Work Carried out under Atomic Energy of Canada Ltd. Contract No. 1951. Koh, K. J.; Leffek, K. T. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Dept. of Chemistry). Aug 1973. 63p. INIS.

Persistent foams are formed as a result of the reaction between hydrogen sulfide and anti-foaming agents in the high pressure reactor (Paar Pressure Reactor) at 200 PSI, 130°C for 20 hours reaction. Other additives, such as coagulant aid, seal oil, and some other ingredients of the antifoaming agent were also examined. An experiment showed that the temperature gradient of the reactor may promote foaming by concentration of trace surfactant or pollutants on the cold surface of the water in the reactor. A literature survey revealed that every physical and chemical condition used by the heavy water plant could promote foaming, and also that considerable amounts of surfactants (fatty acids, protein etc.) are believed to be present in natural waters. A modified high capacity soxhlet apparatus has been used and found to extract organics from carbon filters conveniently. The efficiency was determined quantitatively. The differences in the total amounts of organics between raw and filtered waters from C.G.E. Port Hawkesbury, Bruce, and Savannah River generally were not significant. The characterization of organics in the ethanol extracts was attempted using uv and fluorescence spectroscopy (evidence of aromaticity in the extracted organics), and liquid-liquid and gas chromatography. The establishment of a relationship between uv, fluorescence intensity and total organics was also attempted. High foaming substances in the ethanol extracts were found to possess high molecular weights (~12,000 to 50,000) by dialysis and centriflo ultrafiltration (membrane separation) experiments. High foaming dialyzed substances were concentrated by a foam separation technique, and separated through Sephadex gel filtration to estimate the molecular weights of the foaming substances. Those high foaming fractions from the ethanol extracts showed a close relationship between pH and the foamability; at the lower values of pH, less foam was observed. A further characterization of the foamers is under progress by means of their mass spectra. (auth)

994 (JINR-E13-8361) STUDIES OF THE ION SOURCE WITH SURFACE-VOLUME IONIZATION. Latuszynski, A.; Raiko, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

The ionization processes occurring in a closed volume of an ion source at high temperatures are considered. Expressions have been found for the ionization degree as a function of temperature and density of the ion current extracted from the volume. The results are presented of the experimental investigation of the suggested mechanism of the ion source. The results indicate the ion source is especially useful when using ultrasmall quantities of feed material such as in mass spectrometry and in on-line mass separators for obtaining short-lived radioisotopes. (WHK)

995 (RT/ING-74-9) HEAVY WATER PRODUCTION: INDUSTRIAL PROCESS AND PLANTS. A Bibliography, 2nd Rev. Edition. Lavrenci, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1974. 380p. INIS.

The bibliography covers the literature published on the heavy water production. The material is arranged under the following subject headings: General Bibliographies, Determination and Analyses of Deuterium and Heavy Water, Heavy Water Production (processes, patents, plants, technical and economical aspects), Heavy Water Reactors, Conferences on Heavy Water and Heavy Water Reactors. Three summary tables on heavy water production plants and HWRs in the world, and some schemes of the production plants are also included. (INIS)

996 (UCRL-75725) SEPARATION OF URANIUM ISOTOPES BY LASER PHOTOCHEMISTRY. Snavely, B. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jun 1974. 25p. (CONF-740617-10). Dep. NTIS $4.25.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

The reasons for the current interest in the separation of uranium isotopes are discussed followed by several of the possible approaches to uranium enrichment by laser photochemistry. A discussion of the major problems associated with the large-scale system required for uranium enrichment and the progress which has been made on laser isotope separation is presented. Several slides are used in presenting the information. (TFD)

997 ON THE PROBLEM OF URANIUM ENRICHMENT USING LASERS. Schaefer, F. P. (Max-Planck-Institut fuer Biophysikalische Chemie (Karl-Friedrich-Bonhoeffer-Institut), Goettingen (F. R. Germany)). Naturwissenschaften; 61: No. 6, 257-259(Jun 1974). (In German).

A report of the situation on the present state of the photochemical isotope enrichment is given. Due to the development of the frequency changing laser, the original limitation of the process on small conversions caused by the small capacity of the light sources used, has been removed. The fundamentals of the photochemical isotope enrichment are discussed and the suggestions published up to present for the enrichment of uranium with lasers are described. The theoretically obtainable efficiency is assessed and the thus possible reductions in cost compared to the processes used up to now are discussed. Furthermore, a review is given on the activities in the field of uranium isotope separation with lasers as far as these are known. (GE)

998 METHOD AND FACILITY FOR THE PRODUCTION OF DEUTERIUM-ENRICHED WATER OR HYDROGEN. Hartmann, F.; Ergenc, M. S. (to Sulzer Bros. Ltd., Winterthur (Switzerland)). German(FRG) Patent 2,013,721/B/. 4 Apr 1974. 8p. (In German).

The patent claim deals with the manufacture of deuterium-enriched water or hydrogen combined with a hydrogen-obtaining process by catalytic splitting of hydrocarbons, as well as with the equipment used to carry out this method. The hydrogen formed in the hydrocarbon splitting gets poorer in deuterium content while the added fresh water in the obtaining of hydrogen is enriched with deuterium. These two media are not however put into direct isotope exchange, an intermediate carrier medium – ammonia here – enables the transition. With the help of known catalysts and the freely chosen favorable temperatures for the isotope exchange ammonia-water as well as the isotope exchange between hydrogen to be released and ammonia, an extremely high yield of deuterium and a large enrichment of water is obtained. This enables a highly economical equipment to be used industrially. (GE)

999 AERODYNAMIC SEPARATION METHODS. Campargue, R.; Fenn, J. B.; Hamel, B. B.; Muntz, E. P.; White, J. R. Trans. Amer. Nucl. Soc.; 20: 799-800(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1000 PHYSICS AND TECHNOLOGY OF THE SEPARATION NOZZLE PROCESS. Becker, E. W.; Bier, W.; Ehrfeld, W.; Schubert, K.; Schuette, R.; Siedel, D. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 20: 801-802 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1001 GARDEN HOSE SEPARATION OF GASEOUS ISOTOPES. Wang, C. G. (Massachusetts Inst. of Tech., Cambridge). Nature (London); 253: No. 5489, 260-262(24 Jan 1975).

A new variation of the "time-of-flight" process for the separation of gaseous isotopes is described, using UF_6 gas as an example. The gas is channelled into an evacuated chamber through a set of rotating supersonic nozzles at a small retarding angle so that the ejected gas has zero angular momentum. Inside the vacuum chamber the molecules travel according to their thermal velocities plus a common ejection velocity. A schematic representation of the required rotating collectors is shown. Once a molecule enters a collector it is swung towards the chamber wall by the centrifugal force, and it is stored and pressurized by a rotating wall outside the chamber. There can be up to six sets of nozzle-collector combinations operating at the same plane. The storage chamber has compartments for enriched, depleted, and recycle concentrations. There are no moving parts relative to the chamber in the collector-nozzle-chamber combinations, and by operating under vacuum UF_6 can be stored in solid form and the flow controlled in addition by thermal evaporation. A theoretical analysis of the system is made together with estimates of the specific power requirements, which are found to be only 22% of the theoretical minimum requirement of the diffusion process. The throughput is, however, relatively low, and therefore the specific capital cost may be higher. The number of processing stages required can be lower by over an order of magnitude. The method also compares favorably with the centrifuge method. (UK)

1002 URANIUM ENRICHMENT BY THE LASER METHOD. Dibbert, H. J.; Meyer-Kretschmer, G. (Uran-Isotopentrennungs-G.m.b.H. (URANIT), Juelich (F. R. Germany)). Atomwirt., Atomtech.; 20: No. 2, 73-76(Feb 1975). (In German).

From the present point of view, two methods of separating uranium isotopes by means of laser light are feasible: (1) Ionization of selectively excited atoms or molecules by means of another light source and subsequent electromagnetic separation of the isotopes. The selective excitation and subsequent ionization of uranium atoms does not involve any basic difficulties. (2) Chemical conversion with suitable reactors of selectively excited atoms or molecules. This latter approach makes use of the fact that an excited atom or molecule will react more quickly with the proper reactant by a factor which is an exponential function of the excitation energy in relation to the thermal energy. Great attention is being devoted to the separation of uranium isotopes by the laser method in the Soviet Union, France, the United Kingdom, the United States, Israel, and the Federal Republic of Germany. In the U. S., funds have been raised from 1.5 million in 1974 to 10 million in 1975. The experience gained up to now exhibits still quite important difficulties which can be resolved only by considerable effects. (auth)

1003 SUPPORTING PIVOTAL MOUNTING FOR CENTRIFUGAL SEPARATOR BOWLS. Pfeifer, H. (to CEA). French Patent 2,190,531/A/. 29 Jun 1972. 16p. (In French).

The female portion rests on resilient damping means characterized in that it comprises a resilient hollow beam of cylindrical shape at the upper end of which is a support-oil chamber provided at the bottom with a spherical cup or socket which is the female part of the bowl-bearing, a hollow damping support member of slightly tapered shape, and a substantially cyclindrical jacket fixed to the support member. The jacket is adapted to enclose said beam and support member tightly so as to define a space filled with damping oil of almost constant viscosity. (FR)

Isotopic Power Sources

Refer also to abstracts 169, 362, 365, 373, 374, and 376.

1004 (AD/A-002129) SOME CHARACTERISTICS OF RADIOISOTOPE POWER SOURCES IN AN OCEAN ENVIRONMENT. Erdmann, R. C.; Gritton, E. C.; Ozeroff, M. J. (Rand Corp., Santa Monica, Calif. (USA)). Mar 1974. 33p. (P-5056-1). NTIS $3.75.

The results of the study show that lightweight radioisotope heat sources can be considered for use undersea with little shielding necessary for electronic packages in close proximity to the heat source. Acceptable integrated electronic dose levels of 10^7 rads for gamma irradiation and 10,000 reps for neutron bombardment were obtained for extended mission times for the three isotopes considered. It is unnecessary to shield the isotope ^{210}Po for electronic protection. However, use would be restricted because of its short half-life and this isotope could present special heat management problems not encountered with either ^{60}Co or ^{244}Cm. For ^{244}Cm and ^{60}Co it was found that the shield around the electronic package becomes important due to the strong back scattering effect of neutrons and gammas from the surrounding seawater. The ^{244}Cm heat source appears to require less shielding to electronics level and would therefore take up less volume in the undersea system than the ^{60}Co heat source. (GRA)

1005 (MLM-2183) ULTRASONIC INSPECTION OF THE STRENGTH MEMBER WELD OF TRANSIT AND PIONEER HEAT SOURCES. Dudley, W. A. (Mound Lab., Miamisburg, Ohio (USA)). 1 May 1975. Contract AT-33-GEN-53. 17p. Dep. NTIS $4.00.

A nondestructive technique was developed which allows ultrasonic inspection of the closure weld for the strength member component in plutonium-238 radioisotopic heat sources. The advantage of the ultrasonic approach, over that of the more commonly used radiographic one, is the recognized superiority of ultrasonic testing for identifying lack-of-weld penetration (LOP) when accompanied by incomplete diffusion bonding. The ultrasonic technique, a transverse mode scan of the weld for detection of LOP, is primarily accomplished by use of a holding fixture which permits the vented heat source to be immersed into an inspection tank. The mechanical portion of the scanning system is a lathe modified with an inspection tank and a manipulator. This scanning system has been used in the past to inspect SNAP-27 heat sources. The analyzer-transducer combination used in the inspection is capable of detecting a channel type flaw with a side wall depth of 0.076 mm (0.003 in.) in a weld standard. (auth)

1006 RADIONUCLIDE BATTERIES. P. 1. Basic Principles and Limitations. Schalch, D.; Scharmann, A. (Giessen Univ. (F. R. Germany). Physikalisches Inst.); Euler, K. J. (Gesamthochschule Kassel (F. R. Germany). Arbeitsgruppe fuer Technische Physik). Kerntechnik; 17: No. 1, 23-25(Jan 1975). (In German and English).

A review is given of conversion methods (thermoelectric, thermionic, thermophotovoltaic, radiophotovoltaic, photoelectric, radiovoltaic-betavoltaic, dynamic converters, direct charging, and contact potential). Selection of radionuclides, performance and range of applications of radionuclide batteries are discussed. (FR)

1007 CARDIAC PACEMAKER THERAPY: STATE OF THE ART. Results of Previous Experience and Tendency of Future Development. Irnich, W. (Technische Hochschule Aachen (F. R. Germany). Abt. Innere Medizin 1). Herz Kreislauf.; 6: No. 3, 95-101(Mar 1974). (In German).

Fifteen years after implantation of the first pacemaker, this form of therapy can be termed as one of the most effective in cardiology. By the end of 1973, about 28,000 patients with pacemakers were alive in the Federal Republic of Germany. Their number is still increasing. In comparing the actual numbers of implanted pacemakers in various countries, it is obvious that the Federal Republic of Germany holds a very favorable position in this regard. Life expectancy of patients with pacemakers is slightly over 72 years, and is higher, as compared to patients with similar disease that are treated with only drugs. Electronic improvements and better batteries have prolonged the functional capacity and time of cardiac pacemakers within recent years, and it is now possible to have pacemakers function for 40 months and more. The future might bring even longer-lasting pacemakers, as newer energy sources become available for pacemaker technology. The main problem in relation to implantation seems to be the fixation of an atrial electrode without complications. Only a solution of these problems will enable us to treat the various cardiac conduction disturbances optimally. (auth)

1008 EXPERIENCE IN THE USE OF CARDIAC PACEMAKERS WITH 147 PROMETHIUM BATTERIES. Rosenkranz, K. A. (Berufsgenossenschaftliche Krankenanstalten Bergmannsheil, Bochum (F. R. Germany). Kardiologische Abt.). Herz Kreislauf.; 6: No. 3, 106-108(Mar 1974). (In German).

Since February, 1973, 19 patients (10 female and 9 male), with an average age of 44 y, had Biotronik pacemakers with ^{147}Pm batteries ("Betacel 400") implanted. Impulse conduction was achieved through transvenous catheter electrodes (25 wire hook electrodes and 7 collar electrodes). Thirteen atrial synchronized, and six R wave triggered pacemakers were implanted. Among the latter, two were implanted in patients with sinu-auricular block. The experience is discussed in detail. (auth)

Radiation Sources

Refer also to abstracts 169, 1096, and 1375.

Design and Fabrication

1009 UNDERWATER VARIABLE-GEOMETRY IRRADIATOR. Entwistle, B.; Gawn, P. D.; Du Plessis, T. A. (Atomic Energy Board, Pretoria). Int. J. Appl. Radiat. Isotop.; 26: No. 1, 40-41 (Jan 1975).

A simple and versatile underwater variable geometry irradiator, which combines low manufacturing cost with a high safety factor, is described. The rig was designed to be housed in the Pool Irradiation Facility of the South African Atomic Energy Board. Austenitic stainless steel is used in the construction and 12 vertical concentric source tubes each house a ^{60}Co pencil of the AECL C188 type. Dose rates along the center axis of the sample container can be varied between 3.0×10^4 rad/h (four pencils with source pitch dia of 60 cm) and 2.4×10^6 rad/h (twelve pencils with source pitch dia of 10 cm) by altering the source pitch dia and/or the number of pencils in the array. (UK)

1010 A DEVICE FOR IRRADIATING AT A NORMAL INCIDENCE, A SURFACE GENERATED BY THE MOVEMENT OF A CIRCLE OR A CIRCLE PORTION, BY MEANS OF A BEAM OF CHARGED PARTICLES. Bensussan, A. (to Thomson-CSF). French Patent 2,201,523/A/. 28 Sep 1972. 13p. (In French).

This device permits to irradiate at a normal incidence, any surface the cross-section of which is a circle or a circle-portion (e.g. a cylinder, a sphere or a torus). It comprises means for angularly scanning a beam F of particles in a plane P, and a stigmatic deviation device for deviating said beam, comprising at least one deflector D formed of two electromagnets each of which is provided with two polar pieces so shaped that the emerging trajectories all converge toward a point A of plane P coincident with the center of curvature of cross-section G. Such a device ensures an evenly distributed irradiation of cylindrical, spherical or tonic surfaces along successive arcs which can be greater than 180 deg. The device can advantageously be used in X-ray generators provided with, e.g., a semi-cylindrical target. (auth)

Industrial Uses

Refer also to abstracts 621, 625, 1062, and 1087.

1011 (WANL-TMI-1908) X- AND GAMMA RAY TRANSMISSION MEASUREMENTS USING ISOTOPIC SOURCES. Roesmer, .. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 23p. Dep. NTIS $4.25.

Experiments performed to measure, with a statistical accuracy of 1%, the transmission of x rays and gamma rays in the 14 keV to 88 keV range through filter materials are described and transmission measurement data are presented for the following isotopes: ^{57}Co, ^{103}Ru, ^{109}Cd, ^{113}Sn, ^{137}Cs, ^{129}I, ^{181}Hf, and ^{204}Tl. This work demonstrated the feasibility of using radioisotopes as X- and gamma-ray sources for transmission measurements at energies higher than those accessible by x-ray fluorescence techniques. (LCL)

1012 (ZAED-BIBL.-05-14) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 5. Irradiation of Foods. Number 14. Muenzner, R.; Delincee, H.; Ehlermann, D.; Gruenewald, T. (compss.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Jan 1975. 44p. (In German and English). Dep. NTIS (US Sales Only) $5.25.

The bibliography is based on original documents, mostly from the years 1972 to 1974 which are available at the library of the Bundesforschungsanstalt or from ZAED. In order to make the offered information more accessible to the user, relevant index terms are taken not only from the title but from the whole document. The index terms are given in English. They are listed in the subject register in alphabetical order. They are also presented in the bibliographic section so as to provide additional information on the contents of each document. The bibliographic section is divided into subject categories. Cross references are given when a document concerns more than one subject category. (TFD)

1013 CRITICAL EVALUATION OF AN OPERATIONAL BULK-GRAIN AND PACKAGED PRODUCT IRRADIATOR. Tilton, E. W. (Agr. Res. Serv., Savannah); Brower, J. H.; Cogburn, R. R. Int. J. Radiat. Eng.; 1: No. 1, 59-51(Jul 1971).

A detailed description of the world's only operational bulk-grain irradiator located at Savannah, Georgia, is presented. The unit can process up to 4.5 metric tons of grain per hour. The irradiator includes a grain-handling and treatment system, a source and a source handling system, and a packaged-product irradiation system. Large-scale tests involving bulk grain and packaged-products have been completed. Based on these tests a critique of disadvantages encountered in the present design and suggestions for possible engineering improvements in the irradiator are given. (auth)

1014 DESIGN OF MODERN MEDICAL PRODUCTS IRRADIATORS. McKinnon, R. G. (Atomic Energy of Canada Ltd., Ottawa). Int. J. Radiat. Eng.; 1: No. 1, 1-14(Jul 1971).

The Commercial Products Group of Atomic Energy of Canada Limited (A.E.C.L.) has designed, developed, and manufactured a number of process irradiation plants.The majority of these plants have been constructed for the purpose of radiosterilization of medical products. The design principles involved in making such a plant are discussed. The main components and overall control are considered individually and particular emphasis is placed on safety. (auth)

1015 TABULATED DOSE DISTRIBUTION DATA FOR γ IRRADIATOR DESIGN. I. Cobalt-60 Square Plaque Sources. Rizzo, F. X. (Brookhaven National Lab., Upton, NY); Galanter, L.; Krishnamurthy, K. Int. J. Radiat. Eng.; 1: No. 1, 15-48(Jul 1971).

The data tabulated makes available information necessary to perform quick and reasonably accurate calculations of the dose distribution characteristics of irradiators using ^{60}Co plaque sources. The data presented are depth dose distributions in semi-infinite homogeneous media for 6 target densities (0.1 to 1.3 g/cm^3) and 37 target depths (0 to 36″), from square source plaques of 7 sizes (10×10″ to 120×120″), at 8 different air gaps (0 to 7″). The data are suitable for use with batch, multipass, and quadrant type irradiators. (auth)

1016 RADIATION VULCANIZATION. Morganstern, K. H. (Radiation Dynamics, Inc., Westbury, NY). Int. J. Radiat. Eng.; 1: No. 1, 87-102(Jul 1971).

After considering the energy requirements of rubber vulcanization achieved by heat and by radiation processes, the six fold reduction in dose requirements, over the last two decades, is pointed out. The improvements in the performance of suitable irradiation equipment over the last two decades are discussed, stressing the resulting six fold reduction in processing costs. Several additional technical process advantages of radiation vulcanization over the conventional heat process are discussed. (auth)

1017 2000 CURIE COBALT-60 GAMMA-RAY IRRADIATION FACILITY FOR BIOLOGICAL STUDIES. Yamagata, H. (Kyoto Univ.). Int. J. Radiat. Eng.; 1: No. 1, 69-80(Jul 1971).

A gamma-ray irradiation facility for biological studies, comprising a 2000 Ci ^{60}Co source, was installed at the Faculty of Agriculture of Kyoto University in 1967. This facility is composed of a building, a gamma-ray irradiation system and an environment regulation system. The irradiation field shape is nearly a semicircle and is equally divided into three irradiation rooms. In all the rooms the conditions of temperature, humidity and illumination are separately regulated. Two control rooms, being adjusted to the same conditions as those of irradiation rooms, are installed for analysis of radiation effects. The source strength of 2000 Ci is distributed into 20, 180 and 1800 Ci sources, which can be selected by remote operation. Three lead filters, remotely operated, are provided in each irradiation room, and each of them attenuates the dose rate to one-tenth. The temperature of the irradiation room is adjustable within the range of 5 to 15°C for one room and 15 to 30°C for the other two rooms, and can be automatically changed by means of timers. The humidity is kept within 50 to 90% in these rooms. The illumination intensity of each room can be set at 5000, 500 and 0 lux at the floor level. Lighting time is also set by means of timers. (auth)

1018 IRRADIATOR DESIGN CALCULATIONAL TECHNIQUES BASED ON CENTERLINE DEPTH DOSE DISTRIBUTIONS. Rizzo, F. X. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Eng.; 1: No. 6, 549-584(Dec 1971).

Quick, easy and reasonably accurate methods of calculating dose distributions in irradiators are described. These methods should allow the designer to quickly handle most of the preliminary irradiator design problems in conjunction with tabulated data dealing with depth dose distributions and uniformity ratios for typical irradiator geometries and targets. Principles of gamma irradiator design are discussed covering both general design considerations and practical design concepts for single-slab two-position, two-slab single-position, single-slab multiposition, and two-slab multiposition stationary irradiators, single-slab two pass or multipass,

single-direction irradiators, and two-direction multipass irradiators, including in the latter case the very common variant—the multiposition, shuffle-dwell irradiator. After discussing general dose distribution patterns in large gamma irradiators of the above types, some specific irradiator design considerations are outlined referring particularly to estimation of lateral dose distributions, and static equivalent calculational models for each type. A series of illustrative calculational examples are presented. (auth)

1019 H. S. MARSH NUCLEAR ENERGY LTD.: IRRADIATION FACILITIES MANUFACTURER. Strong, W. J. R. (H. S. Marsh Nuclear Energy Ltd., Reading, Eng.). Int. J. Radiat. Eng.; 1: No. 2, 149-168(Aug 1971).

The activities of H. S. Marsh Nuclear Energy Ltd., a licensee of the UKAEA, are briefly described. The first two prototypes of ^{60}Co radiation sterilization facilities manufactured by H. S. Marsh are described giving design principles and detailed engineering information on the major components involved in the safe treatment of the products. (auth)

1020 SOME CONSIDERATIONS OF INTERLOCKING AND SAFETY CIRCUITS FOR RADIOTHERAPY APPARATUS. Post, R. J. (Hammersmith Hospital, London). Int. J. Radiat. Eng.; 1: No. 2, 169-191(Aug 1971).

Both the design of the circuits and the components used will to some extent determine the inherent safety of the control system of a radiotherapy apparatus. This paper discusses some of the principles of safety circuit design and gives examples of circuits that can be used to perform specific functions. The effects upon system safety of the design characteristics of some components are also discussed. The current trend towards the use of static logic elements in safety systems is briefly considered and some reference is made to safety techniques used in other disciplines such as railway signalling and the control of nuclear reactors. (auth)

1021 TABULATED DOSE DISTRIBUTION DATA FOR GAMMA IRRADIATOR DESIGN. II. Cesium-137 Square Plaque Sources. Rizzo, R. X.; Galanter, L.; Krishnamurthy, K. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Eng.; 1: No. 2, 115-148(Aug 1971).

The data tabulated makes available information necessary to perform quick and reasonably accurate calculations of the dose distribution characteristics of irradiators using ^{137}Cs square plaque sources. The data presented are depth dose distributions in semi-infinite homogeneous media for 6 target densities (0.1 to 1.3 g/cm^3) and 37 target depths (0 to 36″), from square source plaques of 7 sizes (10 × 10″ to 120 × 120″), at 8 different air gaps (0 to 7″). The data are suitable for use with batch, multipass, and quadrant type irradiators. (auth)

1022 NOVEL RADIONUCLIDE APPLICATIONS IN MEASURING TECHNIQUES AND PROCESS ENGINEERING. Hossner, R. Chem. Ind. (Duesseldorf); 26: No. 9, 563-568(Sep 1974). (In German).

A survey on import, export, and market for radioisotopes (unsealed and sealed sources) in the FRG is presented. Typical examples include: radiometry gages in process engineering; radionuclide batteries; industrial radiography; large radiation sources for radiation chemistry and sterilization purposes; tracer techniques; and radiometric chemical analysis such as activation analysis. (GE)

1023 THE SAFETY OF INDUSTRIAL APPLIANCES WITH SEALED RADIOACTIVE SOURCES. Chatelet, J.; Touzin, R. (Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France). Lab. National d'Essais). Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 175-179(Oct 1974). (In French).

From 8th national congress of the Association of Senior Radiation Protection Technicians; Chatenay-Malabry, France (5 Jun 1973).

The principles governing the safety of industrial appliances with sealed sources are explained. As the sealed sources contained in the appliances maintain their integrity in severe conditions, the only functions that the appliances have to provide in terms of safety are: retaining the sealed source; radioprotecting the neighbourhood. To which the operational safety of the appliance must be added. Existing literature covers a good part of the industrial applications; those applications for which no regulations exist as yet are those that are little used or those where the hazard in use is small. (FR)

LIFE SCIENCES

1024 SOME CLASSES OF HIT-THEORY MODELS. Turner, M. E. Jr. (Univ. of Alabama, Birmingham). Math. Biosci.; 23: No. 3-4, 219-235(Apr 1975).

The quantum biological theory of the interaction (hits) between radiation particles and targets necessary for survival is axiomatically developed. Extensions, to include both biological variability in the probability of a hit and variation in the number of targets, are carried out. The problem of adjustment for spontaneous death is explicitly treated by zero-truncation of relevant distributions. A catalog of thirty-nine models is presented in three tables. Many of these are new. The problem of the aliasing of models resulting from different assumptions is briefly treated. An operational approach to hit-theoretic modelling is presented. The notion of a principle of duality is used to explicate the relation between continuous tolerance-dose distributions and quantal dose-mortality curves. Implications for the theory of bioassay are pointed out. The compendium of hit-theory models will enable the biological investigator to choose an appropriate model for a particular investigation and aid awareness of a set of alternative models which may be consistent with experimental data. (auth)

Radiation Effects on Biochemicals

1025 (COO-2364-2) MECHANISMS FOR RADIATION DAMAGE IN DNA. Progress Report, August 1, 1974–July 31, 1975. Sevilla, M. D. (Oakland Univ., Rochester, Mich. (USA)). 1975. Contract AT(11-1)-2364. 12p. Dep. NTIS $4.00.

A mechanism is proposed for radiation damage to DNA and a series of experiments utilizing electron spin resonance spectrometry to test the proposed mechanism is described. Investigations completed or nearing completion are: studies of electron transfer reactions in dinucleoside phosphates; studies of the anions of 5-nitropyrimidines and their reactions; and studies of protonation reactions at carbon sites in anion radicals of certain model compounds and aromatic amino acids. In the first study, the relative electron affinities of the DNA bases were determined in a model system of the DNA strand. In addition, study of the reactions of these anions showed that the thymine anion is the most reactive of the DNA bases in this model system. In the second study anisotropic and isotropic spectra of the anion radicals of 5-nitropyrimidines were characterized by newly developed computer simulation programs. Several of the anions were found to react to form iminoxy radicals. The third study showed that protonation reactions at carbon sites in anions are reactions which are general for molecules with unsaturated linkages. Thus, this mechanism is of significance to the radiolysis of many biological molecules, including DNA. (auth)

1026 (COO-2448-1) CHARACTERIZATION OF IONIZING RADIATION DAMAGE IN DNA. Progress Report, May 1, 1974–April 30, 1975. Hawkins, R. B. (Saint Louis Univ., Mo. (USA). School of Medicine). 1975. Contract AT(11-1)-2448. 30p. Dep. NTIS $4.50.

The objective of this research is the characterization and quantitative assay of ionizing radiation induced damage in DNA and nucleoprotein. Two lines of investigation have been pursued. The first is aimed at detection and assay of the amount of DNA to protein covalent cross linkage in coliphage T7. Protein and DNA are labeled with ^{14}C and ^{32}P, respectively. Cross linkage is assessed from the amount of labeled protein remaining with DNA after efforts to separate the two components by countercurrent distribution in a phenol-water system. It has been found that cross linkage occurs in phage irradiated with cobalt 60 gamma radiation while in dilute neutral aqueous solutions of phosphate buffer and phosphate buffer plus 1-histidine. Cross linkage is largely due to indirect effects and accompanied by protein and DNA fragmentation. The second line of investigation is a study of the hydrodynamic and viscoelastic properties of dilute solution of DNA from irradiated bacteriophage and cells. A device for this purpose, which will measure the elastic retardation time of DNA solutions, is being constructed. (auth)

1027 ELECTRON SPIN RESONANCE STUDY OF LIQUIDS DURING PHOTOLYSIS. XVIII. 2,6-Pyridinedicarboxylic Acid. Zeldes, H.; Livingston, R. (Oak Ridge National Lab., TN). Radiat. Res.; 62: No. 1, 28-36(Apr 1975).

ESR studies of radicals present during the photolysis of solutions of 2,6-pyridinedicarboxylic acid and its anions in solutions near room temperature are reported. Spectra were found for four radicals resulting from reduction of the parent compounds. Radicals I, II, and III, respectively, result from hydrogen atom attachment to the nitrogen atom of the parent dicarboxylic acid, its monoanion, and its dianion. Radical IV results from hydrogen atom attachment to a carbon atom meta to the nitrogen of the dianion. Conditions and mechanisms of formation are discussed, and g values and absolute values of hyperfine couplings are reported. (auth)

1028 ESR STUDY OF HYDROGEN EXCHANGE REACTION IN X-RAY-IRRADIATED GLYCINE. Gautney, L. L. Jr.; Miyagawa, I. (Univ. of Alabama, University). Radiat. Res.; 62: No. 1, 12-17(Apr 1975).

The hydrogen-exchange reaction in x-ray-irradiated crystals of glycine was studied with electron spin resonance techniques. An intraradical exchange was detected which took place between the NH_3 hydrogens and the alpha hydrogen of the radical $\dot{N}H_3CHCO_2^-$. The exchange rate was very high so that the change in the absorption could not be followed by the available spectrometer. Another exchange between the hydrogen of the radical and those of the host crystal was also observed. This relatively slow exchange was essentially similar to the exchange reactions observed in x-ray-irradiated crystals of some other amino acids. (auth)

1029 STRAND BREAKS AND SUGAR RELEASE BY GAMMA IRRADIATION OF DNA IN AQUEOUS SOLUTION. Dizdaroglu, M.; von Sonntag, C.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Ruhr, Ger.). J. Amer. Chem. Soc.; 96: No. 8, 2277-2278(16 Apr 1975).

When DNA is gamma-irradiated in deoxygenated N_2O saturated aqueous solution, the OH radicals and H atoms produced in the system will attack the DNA. Nearly all H atoms and the major part of the OH radicals add to the double bonds of the bases but 10 to 20 per cent of the OH radicals react with the sugar moiety by abstracting hydrogen. Three sugars were isolated after gamma irradiation of DNA including: 2,5-dideoxypentose-4-ulose; 2,3-dideoxypentose-4-ulose; and 2-deoxypentos-4-ulose. The mechanisms of the formation of these sugars are discussed. (ERB)

1030 DETECTION OF CORN STARCH IRRADIATED WITH LOW DOSES OF GAMMA RAYS. P. 2. Disappearance of Malonaldehyde from Starches of Various Moisture Contents. Winchester, R. V. (National Nuclear Research Centre, Pretoria (South Africa). Chemistry Div.). Staerke; 26: No. 8, 281(1974).

Presented in part at the 23rd convention of the South African Chemical Inst., Cape Town, January 28, 1974.

Using the thiobarbituric acid test for malonaldehyde, irradiated starch can be detected qualitatively for up to a year after irradiation. If the moisture content of the starch is known, the dose can be determined quantitatively, if below 75 krad, for up to four months after irradiation, and doses between 75 and 200 krad can be determined up to four weeks after irradiation. Decreasing production of malonaldehyde with increased moisture content is ascribed to preferential radiolysis of the water rather than the starch, with formation of hydrogen peroxide. A possible route for the disappearance of malonaldehyde by reaction with hydrogen peroxide is suggested. (auth)

1031 EFFECT OF pH ON THE REACTIVITY OF THE CARBONATE RADICAL IN AQUEOUS SOLUTION. Chen, S. N.; Hoffman, M. Z. (Boston Univ.). Radiat. Res.; 62: No. 1, 18-27(Apr 1975).

The rate constants for the reaction of CO_3^- radicals, generated in aqueous solution by the flash photolysis of $Co(NH_3)_4CO_3^+$, with some sulfur-containing compounds, some amino acids and enzymes, and nitromethane were measured. The radical is significantly more reactive with the deprotonated sulfhydryl group than with the protonated form. The presence of an amino group causes the rate constant to diminish upon deprotonation. The radical is more reactive with the deprotonated imidazole ring in histidine than with the protonated form. Ribonuclease A and tyrosine show the same reactivity pattern with the radical; deprotonation of the phenolic groups in tyrosine increases the value of the rate constant. Lysozyme and alpha-chymotrypsin show pH-independent values. Finally CO_3^- radicals are more reactive with the aci anionic form of nitromethane than with the unionized form. (auth)

1032 EXCISION OF BASES ACCOMPANYING THE EXCISION OF DIMERS FROM DNA OF UV-IRRADIATED YEAST. Ferguson, L. R.; Cox, B. S. (Oxford Univ. (UK). Botany School). Mol. Gen. Genet.; 135: No. 1, 87-90(Dec 1974).

It is demonstrated that pyrimidine dimers induced in the DNA of yeast by uv irradiation become soluble in weak acid during a

period of incubation in growth medium in the dark. This excision is accompanied by the gain of about 18 bases per excised dimer in the acid soluble fraction. The number of dimers as a fraction of total thymine is considerably enhanced in the acid soluble compared to the acid precipitable fraction of cells, suggesting that base excision is specific to dimer-containing regions. (auth)

1033 FORMATION AND CONVERSION OF THE FREE RADICALS IN FROZEN AQUEOUS SOLUTIONS OF PROTEINS IRRADIATED WITH ULTRAVIOLET. Sud'Bina, E. N.; Azizova, O. A.; Kayushin, L. P. (Inst. of Biological Physics, Moscow). Biophysics (USSR) (Engl. Transl.); 19: No. 1, 20-27(Dec 1974).

It was shown that electrons formed in ultraviolet-irradiated frozen aqueous solutions of proteins attached to the -CONH- group of peptide chain with formation of a radical of the peptide group -CHR·$\dot{C}O^-$(H$^+$)·NH-. The radical of the peptide group on exposure to light of 365 mμ broke down with rupture of the bond and formation of the radical -CHR·$\dot{C}O$ which on exposure to light of λ > 550 mμ underwent further photoconversions. In egg and bovine serum albumin, electrons in the main interacted with the NH_3^+ group of lysine with subsequent deamination. (auth)

1034 PHOTOSENSITIZED SPLITTING OF PYRAMIDINE DIMERS IN DNA BY INDOLE DERIVATIVES AND TRYPTOPHAN-CONTAINING PEPTIDES. Charlier, M.; Helene, C. (CNRS, Orleans, France). Photochem. Photobiol.; 21: No. 1, 31-37(Jan 1975).

Indole derivatives, such as serotonin or the oligopeptide Lys-Trp-Lys were able to photosensitize the splitting of thymine dimers in DNA. These indole derivatives have to be bound to DNA in order to efficiently photosensitize the splitting reaction. Serotonin may also induce the photosensitized formation of thymine-containing dimers in native DNA. In this case, an equilibrium was reached when 5% of the total thymines were dimerized. In both cases (splitting and dimer formation), the formation of electron donor-acceptor complexes between either dimers or two adjacent thymine monomers, and excited indole rings, could have been an intermediate step in the reactions. Thymine-dimer splitting would then have resulted from an electron transfer reaction involving the indole ring as the electron donor. These results are discussed with respect to the mechanism of action of the photoreactivating enzyme. (auth)

1035 ABSORPTION CHANGES AND DECAYS OF TRANSIENTS IN IRRADIATED PAPAIN. Clement, J. R.; Lin, W. S.; Armstrong, D. A.; Gaucher, G. M.; Klassen, N. V.; Gillis, H. A. (Calgary Univ., Alberta). Radiat. Biol.; 26: No. 6, 571-577 (Dec 1974).

Pulse-radiolysis studies of aqueous papain solutions have been made over the 50 μs to 0.40 s time-scale and the 300 to 500 nm wave-length range. For the intermediates formed from both e^-_{aq} and OH, the observed changes in optical density over the above time-scale were independent of papain concentration and dose per pulse. They were attributed to sequences of reactions within the same papain molecule. The overall conclusions were similar to those reported previously for the decay of ribonuclease intermediates (Lichtin, N. N., Ogdan, J., and Stein, G., 1972a, Biochem. biophys. Acta, 263, 14; 1972b, Ibid., 276, 124) and their implications for the interpretation of the mechanism of ^{60}Co inactivation of papain are pointed out. (auth)

1036 ESR AND ENDOR STUDIES OF RADIATION DAMAGE IN SOME X-IRRADIATED BIOLOGICAL MOLECULES. Rustgi, S. N. Buffalo; State Univ. of New York (1974). 197p. University Microfilms Order No. 75-7794.

Thesis (Ph.D.).

ESR and ENDOR spectroscopy were used to observe the effects of ionizing radiations on single crystals of 1-methyl cytosine, glycylglycine HNO_3, histidine HNO_3, and glycine $AgNO_3$. Various primary, secondary and final radicals were observed and identified in these single crystals by magnetic resonance techniques. In 1-methyl cytosine, irradiated at room temperature, two hydrogen addition free radicals were characterized using ENDOR. In partially deuterated crystals of glycylglycine DNO_3, on x-irradiation at 4.2°K, NO_3^{2-} was observed as the primary reduction product and NO_2 as the secondary reduction product. The most interesting result of the study has been to show how the presence of the NO_3^- ion determines the course of the reduction process initiated by ionizing radiations. A mechanism for the formation of the secondary reduction product NO_2 from the primary reduction product NO_3^{2-} has also been inferred from these experiments. In glycylglycine HNO_3 crystals grown from water, on x-irradiation at 4.2°K, only the secondary reduction product is observed indicating that transformation from NO_3^{2-} to NO_2 is complete at 4.2°K. In amino acid salt histidine HNO_3, x-irradiation at 4.2°K produces the paramagnetic species NO_3^{2-} and NO_2, respectively the primary and secondary reduction products. The capacity of NO_3^- ions to scavenge electrons can be clearly demonstrated. The intensity of NO_3^{2-} free radical is large compared to that of NO_2 at 4.2°K indicating that the mechanism of the dissociation of NO_3^{2-} and the subsequent production of NO_2 does not proceed efficiently at liquid helium temperature in irradiated histidine HNO_3. However at higher temperatures no NO_3^{2-} gradually transforms into NO_2 as observed by the gradual disappearance of the NO_3^{2-} absorption and a corresponding enhancement of the NO_2 absorption. The ESR absorption from the primary oxidation product is very anisotropic because silver is a heavy atom and there is a large spin-orbit coupling. The hyperfine couplings of the two silver isotopes were successfully determined by the ENDOR technique. The free radical is stable up to 65°K. In aromatic radicals produced in 1-methyl cytosine, the spin density was calculated from the isotropic part of the sigma-proton hyperfine couplings using the semiempirical McConnell's relation. s and p state spin densities of the unpaired electron in NO_3^{2-} and NO_2 free radicals were determined from the isotropic and anisotropic hyperfine couplings respectively. (Diss. Abstr. Int., B)

Radiation Effects on Cells

Refer also to abstract 1053.

1037 (AED-CONF-74-509-036) PARTICLE TRACKS IN A SPECIAL NUCLEAR EMULSION. Katz, R.; Pinkerton, F. E. (Nebraska Univ., Lincoln (USA)). 1974. 14p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). 5 figs.; 9 refs.

There exists a physical detector, Ilford K-2 emulsion, whose response to energetic heavy ions (high-LET radiation) mimics the response of biological cells to these radiations. The identification is based on the computer simulation of published photographs of particle tracks, but much more data will be needed to define the radiosensitivity parameters of the emulsion. (GE)

1038 EFFECTS OF IONIZING RADIATIONS ON DNA REPLICATION IN CULTURED MAMMALIAN CELLS. Makino, F.; Okada, S. (Univ. of Tokyo, Hongo, Japan). Radiat. Res.; 62: No. 1, 37-51(Apr 1975).

The dose-response curve of [^{3}H] thymidine incorporation into the acid-insoluble fraction of cultured mammalian cells, grown in the presence of 10^{-4} M cold thymidine, is different from that of incorporation in the absence of cold thymidine. For quantitative estimation of net DNA synthesis in nonirradiated and irradiated cells, two methods were used: isolation of newly synthesized BUdR-labeled DNA by CsCl gradient centrifugation and a fluorometric estimation of DNA content in the synchronized population. Both methods showed that the depression of [^{3}H]thymidine incorporation in the presence of cold thymidine reflected a depression of net DNA synthesis. Radiosensitive steps in DNA synthesis were examined by the use of alkaline sucrose gradient centrifugation. The rate of replication along the DNA strands was inhibited to a lesser extent than that of over-all DNA synthesis. The labeling patterns of DNA exposed to [^{3}H]thymidine for 20 min indicated that ionizing radiation preferentially interfered with the formation of small-size ^{3}H-labeled DNA pieces. These results suggest that the initiation of DNA replication is more radiosensitive than the elongation of DNA strands whose replication has already been initiated. (auth)

1039 MODIFICATION OF POSTIRRADIATION SURVIVAL OF MAMMALIAN CELLS BY INTRACELLULAR CYCLIC AMP. Lehnert, S. (Columbia Univ., New York). Radiat. Res.; 62: No. 1, 107-116(Apr 1975).

Intracellular cyclic AMP was found to be significantly elevated in V-79 cells by addition to the culture medium of Prostaglandin E_1, or of compounds inhibiting cyclic AMP phosphodiesterase. Cells in which elevated cyclic AMP had been induced by these means showed modified survival after x irradiation. For high cyclic AMP cells, the extent of the shoulder on the survival curve was increased while the exponential slope of the curve was decreased. Thus, more high cyclic AMP cells survive low doses of radiation than do control cells, but with increasing dose the high cyclic AMP cells become progressively more radiosensitive compared with controls. The increased size of the shoulder on the survival curve for high cyclic AMP cells is not correlated with an increased capacity to repair sublethal damage in these cells. (auth)

1040 ULTRASTRUCTURAL OBSERVATION OF RADIATION-INDUCED CHROMOSOMAL DAMAGE AS SEEN BY THE WHOLE MOUNT METHOD. Chromatid Aberrations. Mouriquand, C.; Gilly, C.; Wolff, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. de Biologie Cellulaire). Biomedicine; 21: No. 10, 414-419(10 Oct 1974). (In French).

Chromosomes from HeLa cells and human lymphocytes were prepared by the "whole mount" method after irradiation with 500 rad gamma rays. Three types of radioinduced aberrations are described: incomplete loss of fibrilar material; total "in situ" destruction; breaks and deletions. They seem to represent various degrees of severity in chromatid fibre damage. (FR)

1041 IMPROVED SYSTEM FOR THE ASSAY OF STIMULATION IN MOUSE MIXED LEUCOCYTE CULTURES. Lafferty, K.; Ryan, M.; Misko, I. (Australian National Univ., Canberra). J. Immunol. Methods; 4: No. 2, 263-273(Mar 1974).

The addition of 2-mercaptoethanol to the medium used for the in vitro cultivation of mouse lymphoid cells has allowed the development of a sensitive and highly reproducible mixed leucocyte culture assay. In this system, the thymidine uptake by allogeneic cultures is 10 to 100-fold higher than that previously obtained with the same strain combination (CBA/J → C57B1/6J) and stimulation indices are 5 to 10-fold higher. Factors that affect the degree of stimulation in allogeneic cultures and those that contribute to the variability of the assay are described. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 1030, 1032, 1105, and 1106.

1042 (COO-3571-13) EFFECTS OF RADIATIONS ON DNA AND REPAIR OF THE DAMAGE. Progress Report, February 1, 1974–February 28, 1975. (Yale Univ., New Haven, Conn. (USA)). 1975. Contract AT(11-1)-3571. 15p. Dep. NTIS $4.00.

A number of the factors involved in extracting very large DNA from E. coli cells were analyzed and experimental parameters determined for some of them. Based on these results, processes were developed whereby DNA comparable in size to the entire E. coli genomes was extracted and characterized by sedimentation on neutral sucrose gradients. Some measurements were made of the dependence of mutation in bacteriophage lambda on both phage and host cell genes specifying recombinational processes. For mutation of the phage both by ultraviolet light and the base analog bromouracil, the observed rate depends on the state of the red system in the phage. For mutation of lambda by ultraviolet light, the dependence on the rec system in the E. coli host cell, found previously by others, was confirmed. (auth)

1043 (SAN-953X1) BIOLOGICAL MONITORS OF DNA DAMAGE BY RADIATIONS AND OTHER ENVIRONMENTAL AGENTS. Progress Report, May 1974. Spizizen, J. (USAEC San Francisco Operations Office, Calif.). 1974. Contract AT(04-3)-953. 13p. Dep. NTIS $4.00.

Monolayers of purified spores of repair-defective mutant strains of Bacillus subtilis were used in studies on lethal and mutagenic effects of radiation. Dose-survival and mutation frequency data were obtained with several wave-lengths of uv radiation. Mutation frequencies were higher for spores than for vegetative cells and the use of sporulation and colony morphology markers amplified the detection of mutations. Irradiation by several wavelengths of uv light of B. subtilis bacteriophages and transforming DNA was investigated with repair-defective mutants as hosts. The relative resistance of free DNA to the lethal effects of 300 nm irradiation suggests the formation of unique lesions, such as DNA-protein cross-links in the irradiated phages. Photodynamic inactivation of phages was studied with the result that lesions produced by proflavine and methylene blue were unrepaired in excision repair strains. By contrast, photodynamic inactivation by riboflavin was of the same order of magnitude in excision-repair and wild type strains. A radioimmunoassay was developed for identification of thymine dimers in uv-irradiated B. subtilis DNA. (HLW)

1044 (SAND-75-0037) RATES OF MUTANT PRODUCTION IN BACILLUS SUBTILIS BY DRY HEAT AND GAMMA IRRADIATION. A Preliminary Report. Dillon, R. T.; Conley, M. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

Bacillus subtilis var. niger spores were inactivated by dry heat, gamma irradiation, and combination of the two. The percentage of auxotrophic mutants among the survivors was determined as a function of treatment time over seven decimal reductions of the initial population. For dry heat inactivation the percentage of mutants increased to a maximum and then decreased. In general, similar results were obtained with gamma irradiation although there were more peaks and valleys in the percentage of mutants as a function of irradiation. For some combinations of dry heat and simultaneous irradiation the percentage of mutants obtained was greatly reduced. (auth)

1045 ATP-DEPENDENT SYNTHESIS OF DNA IN γ IRRADIATED CELLS OF E. COLI TREATED WITH TOLUENE. Gaziev, A. I.; Sergeeva, S. A.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino-on-Oke, USSR). Dokl. Akad. Nauk SSSR; 218: No. 6, 1461-1463(21 Oct 1974). (In Russian).

The effect of γ radiation on the ATP-dependent replicative and reparative synthesis of DNA in toluene-treated Escherichia coli cells was studied. The data obtained showed that in the toluene-treated γ-irradiated cells ATP-dependent reparative synthesis of DNA occurs. This synthesis does not depend on the DNA-polymerase I and is not accompanied by the recovery of the single-strand breaks in the DNA. (JSR)

1046 RADIOSENSITIZATION OF MICROCOCCUS RADIOPHILUS. Lewis, N.; Kumta, U. (Bhabha Atomic Research Centre, Bombay). Radiat. Res.; 62: No. 1, 159-163(Apr 1975).

Among the iodine-containing compounds, viz., iodoacetamide (IA), iodoacetic acid (IAA), and potassium iodide (KI) examined for sensitization of Micrococcus radiophilus, IA was found to be the most effective. Vitamin K_5 and N-ethylmaleimide (NEM) did not produce any sensitization. The large difference in the radioresistance of broth and buffer cultures of M. radiophilus has been attributed to an exceptionally efficient de novo synthesis of repair enzymes during irradiation in broth. (auth)

1047 ANTIMUTAGENESIS IN MICROBIAL SYSTEMS. Clarke, C. H.; Shankel, D. M. (Univ. of East Anglia, Norwich, Eng.). Bacteriol. Rev.; 39: No. 1, 33-53(Mar 1975).

There is shown to be a clear need to repeat several studies employing mutations involving known types of base-pair changes. It will be of obvious advantage in some instances to test for antimutagenic effects of chemicals in pairs of strains having and lacking a single well-defined repair function. The extension of antimutagenesis studies from phage and bacterial systems into eukaryotic systems is already taking place. Caution is also necessary in interpreting the antimutagenic effects of radiation-sensitive mutations. Reduction or abolition of mutability in a radiation-sensitive strain need not imply that an error-prone repair gene function is directly implicated in mutagenesis. Known antimutagens are, like known mutagens, so chemically diverse that a search for new types cannot logically be confined only to a few classes of compounds. If naturally occurring antimutagens are one of the normal regulators of spontaneous and induced mutation frequencies, then one might expect to be able to test this hypothesis by a biochemical analysis of some classes of mutators and mutagen hypermutable mutants. Mutators of several types are well known in several microorganisms, and uv hypermutable (hm) mutants have been described by Drake in phage T4, and 2-aminopurine hypermutable mutants have been isolated in E. coli B/r by Burr and Clarke (unpublished data). To date none of these has been investigated for, or shown to be lacking in, an endogenous antimutagen. At a pragmatic level it would be most useful if antimutagens should be found which strongly counteract the mutagenic activities of at least some environmental mutagens, particularly those having desirable pharmacological uses. Antimutagens have already been used, apparently successfully, as adjuvants in chemotherapy of patients in an attempt to reduce the frequency of occurrence of spontaneous antibiotic-resistant bacterial variants. It is tempting to speculate regarding whether or not they might also have some practical use in cancer chemotherapy or prevention. (auth)

1048 ANTIBIOTIC RESISTANCE PLASMIDS OF STAPHYLOCOCCUS AUREUS AND THEIR CLINICAL IMPORTANCE. Lacey, R. W. (Univ. of Bristol, Eng.). Bacteriol. Rev.; 39: No. 1, 1-32 (Mar 1975).

A variety of plasmids were isolated physically, and most antibiotic resistance is thought to be plasmid mediated. A number of characters (e.g., resistance to erythromycin or methicillin, and production of pigment) are determined by genes that do not give clear indications of either plasmid or chromosomal location. Although the formation of a particular plasmid is probably, even in bacterial terms, a very rare event, once formed such an element can spread rapidly among the bacterial population. The spectacular increase in the incidence of penicillinase-producing hospital strains in the late 1940's could have been due in part to this process. Evidence is stronger, however, for the intercell transfer of recently isolated plasmids coding for resistance to fusidic acid (and penicillinase production), or for neomycin, or for tetracycline resistance. Study of bacterial plasmids can resolve fundamental biochemical problems, and give some insight into the life of the cell at the molecular level. But the immediate application of the study of staphylococcal plasmids may be directed towards improving the effectiveness of antibiotic therapy. The most important aspect of future anti-staphylococcal chemotherapy should thus be the limitation of the use of antibiotics, particularly for application to the skin and nose. (HLW)

1049 ULTRAVIOLET-INDUCED MUTATION OF BACTERIOPHAGE LAMBDA. Induction by Conjugation with Ultraviolet Irradiated Donor Cells. Miura, A. (Tokyo Univ. (Japan). Inst. for Medical Science). Mol. Gen. Genet.; 134: No. 1, 21-27(Nov 1974).

Clear mutations of bacteriophage lambda are increased within F⁻ recipients in a cross with ultraviolet (uv) irradiated F' donors, without a direct uv irradiation of recipients. This mutagenesis occurs when phages are also irradiated with uv radiation. The phenomenon is called an indirect uv induction of the mutation. The indirect uv induction of the mutation is also produced by a cross with uv irradiated Hfr male cells, and does not occur when the recipient is defective in recA gene. (auth)

1050 RADIATION SENSITIVITY OF MYCOPLASMA IN BROTH AND COLOSTRUM. Schimmel, D.; Ahlendorf, W.; Burger, E. (Friedrich-Schiller-Univ., Jena, Ger.). Z. Versuchstierk.; 16: 36-40(1974).

The inactivation of mycoplasmas is possible with 300,000 to 400,000 R, for Escherichia coli inactivation in milk and colostrum samples it is necessary to use 1 million R. X-ray sterilized means free of vegetative forms of bacteria and mycoplasmas. Colostrum can be used for breeding of SPF animals without danger for the SPF status. (auth)

1051 INFLUENCE OF DOSE FRACTIONATION ON THE REPRODUCTION OF THE BACTERIAL CELLS. Jaszsagi-Nagy, E.; Lendvay, J. Magy. Radiol.; 27: No. 1, 49-54(Feb 1975). (In Hungarian).

After uv irradiation therapy performed with equipment assuring periodical screening, the rapidity of reproduction of the bacteria coli was examined. If compared with the single irradiation this irradiation in sectors assures the optimal physiological repair. Similarly, the dark reactivation and the phototherapy, resp., applied after the irradiation therapy delay the cell division and thus, promote the repair processes. (auth)

1052 MOLECULAR MECHANISM OF CHEMICAL MUTAGENESIS. Kondo, S. (Osaka Univ.). Gamma Field Symp.; No. 11, 1-10(1972).

From symposium on chemical mutagenesis in microorganisms and plants; Ibaraki-ken, Japan (25 Jul 1972). See CONF-720749-.

Cultures of Escherichia coli were exposed to uv radiation, 4-nitroquinoline-1-oxide, mitomycin C, and a combination of x radiation and N-methyl-N'-nitro-N-nitrosoguanidine. Results led to the conclusion that errors in repair, recombination, and replication were responsible for mutations induced. A table is presented to show mutagenicity patterns of different mutagens in E. coli strains with different DNA repair capacities. (HLW)

1053 MOLECULAR AND ENVIRONMENTAL ASPECTS OF MUTAGENESIS. Conference Held at Rochester, NY, June 4-6, 1973. Prakash, L.; Sherman, F.; Miller, M. W.; Lawrence, C. W.; Taber, H. W. (eds.). Proceedings Publication of the Rochester International Conferences on Environmental Toxicity. Springfield, IL; Charles C. Thomas Publisher (1974). 301p. (CONF-7306114-).

Separate abstracts were prepared for two papers presented at the conference. An additional 14 papers were presented on mutagenesis in microorganisms, whole animals, and mammalian cells. (HLW)

For abstracts of individual papers see: 1054 and 1055.

1054 MUTAGENESIS IN BACTERIOPHAGE T4: DIRECT OR INDIRECT. Drake, J. W. (Univ. of Illinois, Urbana). pp 63-72 of Molecular and Environmental Aspects of Mutagenesis. Prakash, L. (ed.). Springfield, IL; Charles C Thomas Publisher (1974).

From 6th international conference on environmental toxicity: molecular and environmental aspects of mutagenesis; Rochester, New York, USA (4 Jun 1973). See CONF-7306114-.

Only a few rather simple mutagens act by inducing direct mispairing. Many other mutagenic treatments act indirectly, for instance by producing alterations in enzymes of DNA synthesis, by reducing the availability of DNA precursors, or by triggering error-prone repair systems. Examples of these indirect mutagenic treatments are, respectively: amino acid and mRNA base analogues; thymine and cytosine deprivation; and misrepair following ultraviolet irradiation or treatment with alkylating agents such as methyl methanesulfonate. Both the direct-acting mutagens and pyrimidine deprivation promote rather specific mutational pathways, primarily transitions. Misrepair mutagenesis, on the other hand, promotes a wider spectrum of mutational pathways, including both frameshift mutations and numerous base pair substitutions. (auth)

1055 PHENOMENOLOGY OF AN INDUCIBLE MUTAGENIC DNA REPAIR PATHWAY IN ESCHERICHIA COLI: SOS REPAIR HYPOTHESIS. Radman, M. (Harvard Univ., Cambridge, MA). pp 128-142 of Molecular and Environmental Aspects of Mutagenesis. Prakash, L. (ed.). Springfield, IL; Charles C Thomas Publisher (1974).

From 6th international conference on environmental toxicity: molecular and environmental aspects of mutagenesis; Rochester, New York, USA (4 Jun 1973). See CONF-7306114-.

A hypothesis is proposed according to which E. coli possesses an inducible DNA repair system. This hypothetical repair, which we call SOS repair, is manifested only following damage to DNA, and requires de novo protein synthesis. SOS repair in E. coli requires some known genetic elements: $recA^+$, lex^+ and probably zab^+. Mutagenesis by ultraviolet light is observed only under conditions of functional SOS repair: we therefore suspect that this is a mutation-prone repair. A number of phenomena and experiments is reviewed which at this point can best be interpreted in terms of an inducible mutagenic DNA repair system. Two recently discovered phenomena support the proposed hypothesis: existence of a mutant (tif) which, after a shift to elevated temperature, mimicks the effect of uv irradiation in regard to repair of phage lambda and uv mutagenesis, apparent activation of SOS repair by introduction into the recipient cell of damaged plasmid or Hfr DNA. Several specific predictions based on SOS repair hypothesis are presented in order to stimulate further experimental tests. (auth)

1056 CHARACTERIZATION OF A MUTANT OF ESCHERICHIA COLI B/r DEFECTIVE IN MUTATION FREQUENCY DECLINE. George, D. L. New Brunswick, NJ; Rutgers-The State Univ. (1974). 130p. University Microfilms Order No. 75-8398.

Thesis (Ph. D.).

A mutant of Escherichia coli B/r designated mfd is very deficient in the ability to exhibit mutation frequency decline (MFD), the characteristic loss of potential suppressor mutations which occurs when protein synthesis is briefly inhibited after irradiation with ultraviolet light (uv). This mutant is known to excise pyrimidine dimers very slowly, although it is as uv-resistant as its mfd^+ B/r parent strain. We have found that the mfd mutant performs the initial incision step of excision repair normally, but repairs the resulting single-strand breaks much more slowly than the mfd^+ strain. We conclude that the mfd mutant performs the excision step of pyrimidine dimer excision inefficiently, but our data do not rule out the possibility that one or more subsequent steps of repair may also be slow. In spite of the slow dimer excision in the mfd mutant, single-strand DNA breaks do not accumulate during postirradiation incubation, implying that incision and excision are well coordinated. The prolonged postirradiation lag in cell division and DNA synthesis which accompany slow excision in the mfd strain indicates that resumption of these processes of optimal rates is linked to the timing of excision repair. The normal uv-resistance of the mfd mutant also suggests such coordination and shows that the rate of excision repair is independent of its ultimate efficiency in the removal of potentially lethal uv-induced damage. The mfd gene is located between gal (18 min) and trp (27 min) on the E. coli chromosome, in a region that does not contain any genes known to be involved in repair. The yield of uv-induced Tyr^+ revertants (mainly ochre suppressors) and mutations to streptomycin resistance is 4-10x higher in the mfd strain than in the mfd^+ parent. This is comparable to the level of uv-mutability in the mfd^+ strain in the presence of caffeine and acriflavin, inhibitors of dimer excision. The elevated levels of uv-mutability, lambda prophage induction and uv-reactivation of irradiated lambda phage found in the mfd strain at low uv doses (10-50 ergs/mm^2) suggests that the slow repair of excision breaks in this mutant results in a shift in the threshold of induction of uv-inducible functions toward lower uv doses. We have found that suppressor mutations, but not lethal damage or mutations to streptomycin resistance, are photoreversed inefficiently in the mfd mutant, raising important questions about the nature of the MFD-susceptible premutational lesion at suppressor loci. (Diss. Abstr. Int., B)

1057 EFFECTS OF GAMMA IRRADIATION ON BACILLUS PUMILUS E601, A BIOLOGICAL INDICATOR FOR IRRADIATION STERILIZATION. Parisi, A. N. New Brunswick, NJ; Rutgers-The State Univ. (1974). 226p. University Microfilms Order No. 75-8427.

Thesis (Ph. D.).

Experimental studies frequently rely on the use of substerilization treatment doses of irradiation to produce irradiated survivors. Eighteen substrains produced by single substerilization process treatments, visibly altered (nonmotile, no pellicle) at the time of isolation, were characterized. Of these, eight regained normal pellicle forming and motility ability. Three strains were asporogenous. Minimal alterations in enzymic functions were

noted. Radiation resistance of sporulating strains varied in D_{10} values of 0.30 ± 0.06 Mrad. Sporogenous and asporogenous strains needed amino acids not required by the parent. Of eight cultures isolated from production ^{60}Co sterilization (2.5 Mrad) biological indicator sterility tests, five showed no variation from the parent and three were non-motile and had altered colonial morphology. Loss of some enzymic functions were evident. Radiation resistance of the strains (D_{10} values) averaged 0.31 Mrad. The altered strains required from five to thirteen amino acids in addition to the parent requirements for spore outgrowth. A 4.5-fold increase in vegetative cell radiation resistance of B. pumilus E601 was obtained by repeated (23) radiation treatments of surviving vegetative cell populations. Sporulation ability was lost by the fifteenth passage. Other effects included loss of motility, changes in gram reaction, cell and colonial morphology and an increase in nutritional requirements from complete competence to synthesize all its amino acids (parent) to requiring six amino acids. Radiation resistance was not transferred from vegetative cells to their spores. Changes of pH of media also affected the number of irradiated biological indicators showing outgrowth and the speed of outgrowth detection. The optimum for this spore biological indicator was pH 7.0 or 8.0. There was a universal indication among all media that pH 8.0 was better than 7.0. Heat shocking to stimulate germination of irradiated spores resulted in the killing of the apparently (irradiation) sensitized spores of the biological indicators. It was concluded that Columbia Broth (pH 7.5 as manufactured) was the best of the media studied. Since Columbia Broth was far superior to the standard, Eugonbroth, Columbia Broth should provide reliable information when biological indicator tests are incubated seven days. (Diss. Abstr. Int., B)

1058 IRRADIATION OF THE T4 BACTERIOPHAGE IN A 1 MILLION VOLT MICROSCOPE. Preliminary Results. Lapchine, L.; Enjalbert, L. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Optique Electronique; Toulouse-3 Univ., 31 (France)). Compt. Rend., Ser. D; 279: No. 7, 607-610 (12 Aug 1974). (In French).

The survival of the T4 bacteriophage was studied after high voltage irradiations (1 MeV) at doses of 1.23×10^{-6} to 4.4×10^{-5} cb/cm^2. In the experimental conditions presented, the maximum dose that enabled infectious particles of the virus to be found is 7.4×10^{-6} cb/cm^2. (FR)

1059 EFFECTS OF GAMMA IRRADIATION ON THE TWO MECHANISMS OF Rb(K) UPTAKE BY CHLORELLA. Paschinger, H.; Vanicek, T. (Univ., Vienna). Radiat. Bot.; 14: No. 4, 301-307(Dec 1974).

Chlorella has two mechanisms of K uptake, depending on concentration. Mechanism 1 operates at low concentration and may be responsible for net transport. Mechanism 2 is dominant at high concentration (above 1×10^{-3}M) and may be attributed to the K/K exchange system. In either case, Rb, which has a more favorable radioisotope, substitutes for K. Both mechanisms are temperature sensitive, dependent on metabolism, and carrier-mediated. At low Rb concentration (3×10^{-5}M), γ irradiation (60 krad) reduced Rb uptake at 30°C, but increased it at 10°C. At high concentration (3×10^{-3}M), uptake was stimulated by irradiation at both temperatures. With K-deficient cells, the Rb net transport contributed to a higher degree to total Rb influx, compared with normal cells. On γ irradiation of K-deficient cells, at low concentration a decrease of the uptake was observed at both 30 and 10°C, and at high concentration the stimulation was less pronounced than with normal cells at both temperatures. It is suggested that the K/K exchange system is stimulated, but the K (Rb) net transport system is injured by irradiation. The increased K efflux after irradiation is about equal to the stimulated K (Rb) influx via the exchange system. Thus it is not necessary to assume enlarged membrane permeability to explain the increase of the K efflux after γ irradiation. (auth)

1060 DEPENDENCE OF RADIATION SENSITIVITY ON OXYGEN TENSION IN OEDOGONIUM. III. Applicability of the Howard-Flanders-Alper Formula for 14 MeV Neutron Irradiation. Howard, A.; Gilbert, C. W.; Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat. Bot.; 14: No. 4, 351-353(Dec 1974).

In vegetative cells of the green alga Oedogonium cardiacum, sensitivity to killing by 14 MeV neutron irradiation was measured in water saturated with air, N_2, or one of four different low oxygen-content gas mixtures. The results showed a reasonable fit to the Howard-Flanders-Alper formula for the relationship between radiation sensitivity and oxygen tension. The estimated parameters were: $K = 9.308 \pm 0.98\ \mu M\ l^{-1}$ and $m = 1.724 \pm 0.024$. (auth)

1061 EFFECTS OF CONTROLLED ATMOSPHERE ON IRRADIATED LEMON FRUITS. Shrikhande, A. J.; Kaewubon, N. (Univ. of California, Davis). Radiat. Bot.; 14: No. 4, 315-321(Dec 1974).

The effects of controlled atmosphere containing different levels of oxygen and carbon dioxide were studied during and following irradiation of lemon fruits. High CO_2 during irradiation suppressed aerobic postirradiation ethylene production and respiration. Carbon dioxide at all concentrations when applied with 2.5 and 21% O_2 after irradiation of the fruits in air suppressed the rate of C_2H_4 production, minimized chlorophyll and ascorbic acid loss, and delayed physiological disorders in lemons on storage. Oxygen concentrations higher than 21% enhanced the rate of C_2H_4 production and increased chlorophyll and ascorbic acid loss. (auth)

1062 EFFECTS OF IONIZING IRRADIATION ON MUSHROOMS AS INFLUENCED BY PHYSIOLOGICAL AND ENVIRONMENTAL CONDITIONS. Skou, J. P.; Bech, K.; Lundsten, K. (Danish Atomic Energy Commission, Risoe). Radiat. Bot.; 14: No. 4, 287-299(Dec 1974).

The effects of irradiation with β particles (10-MeV fast electrons) and γ rays were studied on several characters in strains of the cultured mushroom under different physiological and environmental conditions, including uncut and cut mushrooms, tightness of packing, and relative humidity. Weight loss was greatest in the non-irradiated mushrooms owing to evaporation from an increased surface area resulting from expansion and ripening which were greatly retarded in the irradiated samples. Twenty-five krads of β- or γ-rays had a significant, but transitory, effect on the veil opening. The inhibition became long-lasting and improved with increasing dose. High relative humidity and free exchange of gases were essential for maintaining quality. Depending on the conditions, expansion of pilei and opening of veils were affected differently by irradiation with β- and γ-rays. The strains displayed different opening rates. Expansion and elongation were retarded significantly by 100 krads. The effect improved further with increasing dose. Irradiation improved the skin color when the mushrooms were stored uncovered or in boxes with perforated PVC-foil. The opposite was the case when the boxes were sealed. The color of the flesh was examined by measuring its reflectance. Edaphic factors or age of the culture (flush-number) influenced the slope of the reflectance curves. Generally, irradiation increased flesh discoloration, but more in the stipes than in pilei. This adverse effect would make acceptance of irradiated mushrooms by consumers questionable. The flesh of the pilei was almost unaffected by the packing, while packing gave a positive response on the stipes. Surface mould fluff was reduced by 50 krads of β- or γ-rays and almost extinct after 200-krad treatment. Growth of pathogens such as Pseudomonas tolaasii and Mycogone perniciosa was prevented by 200 krads. (auth)

1063 EFFECT OF COSOLVENTS ON THE SENSITIVITY OF BENZOCAINE IN AQUEOUS SOLUTION TO IONIZING RADIATION. Fletcher, G.; Davies, D. J. G. (Univ. of Bath, Eng.). J. Pharm. Pharmacol., Suppl.; 26: 83p(Dec 1974).

From British pharmaceutical conference; Nottingham, Eng. (2 Sep 1974).

Pharmaceuticals in aqueous solutions are more susceptible to irradiation than in nonaqueous solutions. Topical preparations such as creams contain a decreased amount of water, and one of the possible factors in reducing the radiosensitivity of the drugs is the presence of cosolvents in the aqueous phase. Gamma irradiation of solutions of benzocaine (1.25×10^{-4}M) in various proportions of ethanol in water, glycerol in water, or polyethylene glycol 200 in water was therefore studied. The benzocaine was markedly less radiosensitive in the water-cosolvent mixtures. (UK)

1064 EFFECT OF SURFACTANTS ON THE RADIATION SENSITIVITY OF BENZOCAINE IN AQUEOUS SOLUTION. Fletcher, G.; Davies, D. J. G. (Univ. of Bath, Eng.). J. Pharm. Pharmacol., Suppl.; 26: 82p(Dec 1974).

From British pharmaceutical conference; Nottingham, Eng. (2 Sep 1974).

In a formulated cream the active drug may partition not only between the oil and aqueous phases but also between the water and surfactant micelles which are present in the aqueous phase. The observed rate of any radiation-induced reaction depends on the fractions of the drug associated with the micelles and the aqueous phase, and also on the micellar and aqueous reaction rate constants. Radiation-sterilization may become a feasible proposition if these parameters can be optimized. The effects of cetrimide and Tween 80 on the sensitivities of aqueous solutions of benzocaine (1.25×10^{-4}M) to ^{60}Co gamma irradiation were therefore investigated. Plots of the residual concentrations of benzocaine against dose for different cetrimide concentrations (10^{-5} to 10^{-2}M) or Tween 80 concentrations (10^{-3} to 10^{-1}% w/v)

showed concentration dependent increasing protection of benzocaine by both cetrimide and Tween 80. (UK)

Radiation Effects on Plants

Refer also to abstracts 777, 1061, 1105, and 2921.

1065 (COO-2085-11) EFFECTS OF GAMMA RADIATION ON LICHENS AND LICHEN-FORMING FUNGI AND ALGAE. Progress Report, April 1, 1974–March 31, 1975. Erbisch, F. H. (Michigan Technological Univ., Houghton (USA). Dept. of Biological Sciences). 1975. Contract AT(11-1)-2085. 9p. Dep. NTIS $4.00.

Xanthoria polycarpa apothecia have been collected from Site 1 of the Enterprise Radiation Forest, fixed, sectioned, and stained for a study of ascus and ascospore development. The study will be completed later this year. Four years of data compiled on the effects of chronic gamma radiation on two species of Parmelia are now being analyzed and correlated. Up to this time most of the analysis has been with P. sulcata. Evidence from Cladonia sylvatica acute radiation studies indicated that radiation damage (macro- and microscopic and physiological) was not manifested until the lichens passed through a period suitable for growth. An experiment has been set up to determine if the growth period is responsible for the change observed. Irradiated (1000 krad) and non-irradiated podetia were placed in the field and others placed in a growth chamber. Those podetia in the growth chamber will not go through a growth period while those in the field will. Comparison of these podetia is going on monthly in regard to: photosynthesis-$^{14}CO_2$ uptake, respiration, usnic acid concentrations, podetial strength, and cytological changes. Although several months data have been collected no conclusion can be drawn yet. (auth)

1066 (COO-2505-01) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Progress Report April 1, 1974–March 31, 1975. Moh, C. C. (Tropical Agricultural Research and Training Center, Turrialba (Costa Rica)). 1975. Contract AT(11-1)-2505. 45p. Dep. NTIS $5.25.

Progress is reported on the following research projects: mutation breeding in cassava (Manihot esculenta) and beans (Phaseolus vulgaris) using gamma radiation; photosynthesis in the cassava leaf; translocation of ^{14}C after assimilation of $^{14}CO_2$; and metabolic fate of translocated photosynthetic carbon. (HLW)

1067 (COO-2505-02) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Triennial Report, July 1, 1972–June 30, 1975. Moh, C. C. (Tropical Agricultural Research and Training Center, Turrialba (Costa Rica)). 1975. Contract AT(11-1)-2505. 72p. Dep. NTIS $6.75.

Progress is reported on the following research projects: mutation breeding in cassava (Manihot esculenta) using gamma radiation; mutation breeding in beans (Phaseolus vulgaris); ^{14}C tracer studies on photosynthesis in the cassava leaf, translocations of ^{14}C after assimilation of $^{14}CO_2$, and metabolic fate of translocated photosynthetic carbon; and collection of rainfall for fallout analysis. (HLW)

1068 INFLUENCE OF RADIATION DOSE RATE ON SOMATIC MUTATION INDUCTION IN TRADESCANTIA STAMEN HAIRS. Nauman, C. H.; Underbrink, A. G.; Sparrow, A. H. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 62: No. 1, 79-96(Apr 1975).

Both x and gamma rays have been used to investigate the effect of dose rate on the induction of pink mutant cells in stamen hairs of Tradescantia clone 02. For inflorescences exposed to doses of 60 to 80 rads of x rays at 0.3 to 503 rads/min there was a progressive increase in the number of mutations/rad/10^4 hairs as the dose rate was increased from 0.3 to 105 rads/min. However, 300 rads/min did not further increase the mutation rate, and at 503 rads/min the effect was slightly less, but approximately equal to that at 30 rads/min. With 58 to 79 rads of ^{137}Cs gamma rays, the mutation rate increased progressively with dose rate over the entire range studied (0.0034 to 30 rads/min). Some inflorescences were held at 8 C before and during irradiation to slow development so that low dose rates (3.4 to 12 mrads/min) could be delivered within a given development period. The mutation rate during cold treatment was higher than when the same dose rates were given during a period of more rapid development under standard growth conditions. Dose-response relationships were established at three radiation intensities, 0.05, 0.5, and 5.0 rads/min, and the resulting mutation rates were related to those from a previously established curve derived at 30 rads/min. Mutation response was independent of dose rate at 10 rads and below, but a progressively lower incidence of mutation was associated with the 5.0 and 0.5 rad/min intensities over at least a 30- to 160-rad range of doses. Response to 0.05 rads/min was not different from that at 0.5 rads/min over the entire 5- to 30-rad range of doses investigated. (auth)

1069 INFLUENCE OF Cu^{2+}, Zn^{2+}, AND Mg^{2+} IONS ON RADIOMIMETIC EFFECTS OF DIETHYL SULPHATE IN ROOT MERISTEMS OF CUMINUM CYMIMUM L. Murty, D. S.; Vaidyanath, K. (Osmania Univ., Hyderabad, India). Indian J. Exp. Biol.; 12: No. 5, 474-475(Sep 1974).

The ability of diethyl sulphate to break chromosomes in conjunction with metallic ions, Cu^{2+}, Zn^{2+}, and Mg^{2+} has been studied. Zn^{2+} and Cu^{2+} ions enhance the frequency of chromosomal aberrations induced by diethyl sulphate, whereas Mg^{2+} ions seem to have a slightly decreasing effect. (auth)

1070 CONSEQUENCE OF NATURAL ELIMINATION OF RADIATION-INDUCED ABERRATIONS ON THE M_2 SEED-SET: ITS GERMINATION AND AGRONOMIC PERFORMANCE OF THE M_2 GENERATION. Shaikh, M. A. Q.; Godward, M. B. E. (Queen Mary Coll., London). Indian J. Exp. Biol.; 12: No. 5, 415-421 (Sep 1974).

Consequence of natural elimination of radiation (^{60}Co) induced aberrations on the seed-set at various ontogenetically different parts of the M_1 meristem, viability of these seeds, and ultimate height and seed yield of M_2 plants developed from these seeds was studied in the Vicia ervilia and Lathyrus sativus. In general, as opposed to control plants, the upper branches of treated plants produced more seeds than the lower ones. Similarly, the upper pod-positions along each branch produced more seeds than the lower pod-positions; this tendency was marked more in lower branches than in higher ones. Seeds from the control plants of both the species, whatever the branch of origin, showed similar percentages of germination. But seeds collected from upper branches of the treated plants showed higher percentages of germination than those of lower branches. In irradiated samples, there was a slight but consistent increase in the ultimate height and seed yield of M_2 plants and a decrease in variability in these characters with the upward shifting of positions of pods and branches. There was no such trend in the plants developed from control seeds whatever their place of origin in the branch and pod-position hierarchy. In general, the results provided conclusive evidence that M_1 plants have more normality in their upper than lower parts due to the elimination of aberrations with the development of the shoot meristem. Possible utilization of this variation in normality of the ontogenetically different parts of a treated plant in mutation breeding is discussed. (auth)

1071 CELL DEVELOPMENT AND IONIZING RADIATION AS RELATED TO AGING IN PLANTS. van Huystee, R. B. (Univ. of Western Ontario, London). Sov. J. Develop. Biol. (Engl. Transl.); 4: 117-121(Mar 1974).

Translated from Ontogenez; 4: No. 2, 123-127(1973).

An attempt was made to study the "basic" mechanism, and particularly, the influence of ionizing radiation. It was established that mRNA is the most vulnerable link in the chain, decomposed by ionizing irradiation. However, it was later found that even macromolecular proteins are broken down by exposure to a massive dose (500 kR) of irradiation. This effect is evidently associated to some degree with processes that occur during aging. Unfortunately, radioautographs revealed that the metabolism of the cotyledons is not uniform in all tissues, as might have been expected; therefore, we turned to a tissue culture of the cotyledon. Initially this culture consisted of an extremely inhomogeneous cell population, but during subsequent culturing a homogeneous population was obtained, in which constant indices of metabolism correspond to definite types of growth. Peroxidase and its isoenzymes were studied. With increasing complexity of the cell masses, supplementary isoenzymes are formed. The effects of irradiation on a homogeneous cell suspension were additionally investigated. High doses suppress cell division. However, cell elongation continues until filamentous cells, many times exceeding the original size, are formed. The rate of protein synthesis after irradiation at first returns to normal, but this effect disappeared during a period of two weeks of subsequent culturing. Moreover, the synthesized proteins were of an entirely different nature from the proteins that were synthesized by nonirradiated cells. These changes in protein synthesis in the irradiated cells were due to errors in the coding of RNA in the irradiated cells; analogous findings for aging cells have been reported by other scientists. (auth)

1072 QUANTITATIVE DESCRIPTION OF THE CELL RADIATION INACTIVATION. VI. Evaluation of Modifying of Dose: Survival Relation for Eucariotic Cells. Barsukov, V. S. (Leningrad Inst. of Nuclear Physics). Ukr. Biokhim. Zh.; 17: No. 3, 314-320(Mar 1975). (In Russian).

The parameters of dose–survival relation in terms of cytogenetic action of radiation are directly connected with real char-

acteristics of experimental survival curves: initial slope, final slope, and threshold. A system for estimation of the elementary modification is suggested. Nine elementary modifications are interpreted in terms of the suggested model which enables to analyze complex kinds of modification. Intermolecular DNA links are considered responsible for non-zero initial slope of survival curve. The final slope of survival curve is determined by double-strand DNA breaks which are due to both the size of target and the efficiency of repair at the hit–primary lesion stage (on molecular level). Threshold of the survival curves is determined by the competition of recovery after primary lesion and the fixation of lethals (assymmetrical chromosome exchanges—cytogenetic level). (auth)

1073 CHEMICAL MUTAGENESIS IN MICROORGANISMS AND PLANTS. Symposium Held at Ohmiya, Japan, July 25–26, 1972. Gamma Field Symp.; No. 11, 1-96(1972). (CONF-720749–).

Separate abstracts were prepared for three papers presented at the conference. An additional paper was presented on genetic fine structure analysis of mutants induced by ethyl methanesulfonate. (HLW)

For abstracts of individual papers see: 1052, 1074, and 1075.

1074 PRODUCTION OF MUTATIONS BY IONIZING RADIATIONS AND CHEMICAL AGENTS IN RELATION TO THE DUPLICATION OF CHROMOSOMES. Yamaguchi, H. (Tokyo Univ.). Gamma Field Symp.; No. 11, 29-42(1972).

From symposium on chemical mutagenesis in microorganisms and plants; Ibaraki-ken, Japan (25 Jul 1972). See CONF-720749-.

Rice seeds were treated with gamma radiation, ^{3}H-thymidine, EMS, myleran, and aminopterin. Barley seeds were treated with DES. Mutation frequencies were recorded in relation to stages of the cell cycle and results are tabulated. (HLW)

1075 COMPARISON OF GENETIC EFFECTS OF GAMMA-RAY IRRADIATION AND TREATMENTS OF CHEMICAL MUTAGENS IN A SIX-ROWED BARLEY. Yamashita, A.; Ukai, Y.; Yamaguchi, I. (Inst. of Radiation Breeding, Ohmiya, Japan). Gamma Field Symp.; No. 11, 73-92(1972).

From symposium on chemical mutagenesis in microorganisms and plants; Ibaraki-ken, Japan (25 Jul 1972). See CONF-720749-.

Dry and soaked seeds of barley were treated with gamma radiation, ethyleneimine, EMS, and nitroso-methyl urea. The seeds were sown and data on mutations were recorded. Graphs and tables are presented to show relationships between dose of radiation, EI, EMS, and NMU and chlorophyll mutations. Relationships between spike fertility, sterility, dwarf mutants, and bright green mutants are also shown. (HLW)

1076 INFLUENCE OF GAMMA AND UV IRRADIATION OF TOMATO POLLEN ON THE HETEROSIS EFFECT IN THE F_1 GENERATION. Daskaloff, C.; Mojnova, K.; Popova-Konstantinova, M. (Sofia Univ. (Bulgaria). Inst. of Genetics and Plant Breeding). Z. Pflanzenzuecht.; 71: No. 4, 341-351(Jun 1974). (In German).

Investigations were carried out in the period 1970 to 1972 with the object of elucidating the influence of gamma and uv irradiation of tomato pollen on the F_1 generation and the relationship between irradiation and the activation of polyphenoloxidase. Treatment of tomato pollen with low doses of uv and gamma rays exerted a stimulating effect on the F_1 generation in respect of seed germination, initiation of flowering and number of flowers, as well as on fruit set and consequently on the earliness index. A direct correlation was found between the activation of the polyphenoloxidase in tomato pollen irradiated with uv and gamma rays and the stimulation phenomena observed during the initial stages of ontogeny. It is assumed that increased activation of the polyphenoloxidase as a result of gamma and uv irradiation is the cause of the stimulation phenomena observed in the initial stages of ontogeny in tomatoes. The results obtained justify the assumption that irradiation of pollen with low doses of uv and gamma rays could be made use of in the production of hybrid seeds of tomato, and possibly of other crops, by increasing the earliness index. (auth)

1077 EFFECTS OF ULTRAVIOLET IRRADIATION ON SURVIVAL AND ON NUCLEIC ACIDS AND PROTEIN SYNTHESIS IN PLANT PROTOPLASTS. Ohyama, K.; Pelcher, L. E.; Gamborg, O. L. (National Research Council of Canada, Saskatoon). Radiat. Bot.; 14: No. 4, 343-346(Dec 1974).

Protoplasts were subjected to increasing doses of ultraviolet irradiation to determine the effect on nucleic acid and protein synthesis, and also on survival and cell colony forming ability. The ability of soy bean protoplasts to form cell colonies was destroyed by exposure to uv irradiation exceeding 192 ergs/mm^2. However, as measured by vital staining, over 90% of the protoplasts remained viable for at least 24 hr after exposure to uv irradiation up to 1920 ergs/mm^2. While DNA and RNA synthesis were sharply reduced by increasing uv dose, protein synthesis was inhibited to a lesser extent. (auth)

1078 FOUR-YEAR POST-EXPOSURE ASSAY OF VEGETATION SURROUNDING PROJECT PIN STRIPE: DEMONSTRATION OF THE UTILITY OF DELAYED DAMAGE APPRAISALS. Ragsdale, H. L.; Rhoads, W. A. (Emory Univ., Atlanta). Radiat. Bot.; 14: No. 4, 229-236(Dec 1974).

This report illustrates the feasibility of using temporally-delayed vegetation assays to determine radiation damage, by documenting the radiation damage resulting from the accidental venting of radioactive materials during Project Pin Stripe, Frenchman's Flat, Nevada Test Site, in April, 1966. Evidence of desert shrub radiation damage was first observed and photographed in April, 1968. Systematic study of the vegetation was initiated in October, 1970, and evidence of radiation damage documented over 72.9 hectares adjacent to the vent. Beta doses were estimated at 15 to 21 krads based on gamma exposure dose measurements. The minimum beta dose estimate was substantially greater than the theoretical lethal dose for the shrub, Larrea divaricata. Radiation damage to the shrubs, Larrea divaricata, Ephedra funerea, and Atriplex confertifolia was expressed as differential bud mortality, partial death of shrub crowns with and without crown regrowth, and total shrub crown death without crown regrowth. Each of the shrub populations was statistically different from its control population with respect to the distribution of individuals among damage classes. Generally, damage patterns were similar to those observed at two previously-studied Plowshare events. (auth)

1079 RADIATION INDUCED VARIABILITY IN QUANTITATIVE TRAITS OF JOWAR (SORGHUM VULGARE, SNOW.). Balyan, H. S.; Srivastava, H. K. (Meerut Univ., India). Curr. Sci. (India); 44: No. 9, 320-321(5 May 1975).

Seeds of hybrid and inbred strains of sorghum were treated with 10 to 35 kR doses of gamma radiation. The seeds were sown and the plants that developed were observed for plant height, number of effective tillers per plant, leaf number, peduncle length, time of blooming, pollen viability, and seed fertility. Results suggested a general shift in mean values in a negative direction with regard to quantitative traits. (HLW)

1080 GENETICAL INVESTIGATION OF TOMATO MUTANTS CAPABLE OF CHANGING THEIR CELL TURGOR. Yakovleva, I. A. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Genetika; 11: No. 2, 47-54(Feb 1975). (In Russian).

Tomato mutants with a restored cell turgor were obtained as the result of the treatment with different mutagens of the tomato mutant "wilty dwarf" with an abnormally low cell turgor. The frequency of initiation of plants with a restored cell turgor was considerably higher in case of x irradiation as compared to that in case of the treatment with chemical mutagens. The genetic study of plants with a restored cell turgor revealed the dominant nature of this character and suggested its monogenic inheritance. Reciprocal grafts of the initial form of the "wilty dwarf" to normal plants and vice versa have shown the effect of the root system on the state of the cell turgor. Plants with a restored cell turgor, i.e. those carrying the dominant mutation, appeared in the M_2 and were lacking in the M_1. This can be explained by the initiation of the dominant gene in the part of the plant, the characters of which are not substantially affected by this gene, i.e. in the tissues of the plumule, not of the radicle. The results of the segregation in the progeny of the M_2 plants, as well as in the F_1 from the backcross, suggest two possible ways of the recovery of the cell turgor: the appearance of this character—the recovery of the cell turgor in consequence of a mutation of a non-allelic gene, the gene-suppressor being closely linked to the gene responsible for the turgor state of cells; or the appearance of a series of multiple alleles of the gene studied. Further genetic studies are required for the decisive solution of this problem. (auth)

1081 INVESTIGATION OF THE ACTION OF γ RAYS ON THE SOMATIC EMBRYOGENY IN DAUCUS CAROTA L. Effect on the Growth of the Cal and the Initiation of the Embryos in Vitro. Norreel, B.; Rao, P. S. (Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Lab. de Physiologie Pluricellulaire, Bhabha Atomic Research Centre, Bombay (India)). Compt. Rend., Ser. D; 279: No. 9, 751-754(26 Aug 1974). (In French).

The small γ irradiation doses, in certain varieties of carrot, stimulate the growth of cals and the initiation of embryos. The most favourable dose is between 1000 and 4000 rads. However the induced embryos are then incapable of germinating normally. (FR)

1082 ACCELERATED AND INCREASED DEVELOPMENT OF INFLORESCENCES IN TOMATO PLANTS FROM IRRADIATED

SEEDS. Kahan, R. S. (Israel Atomic Energy Commission, Yaune). Radiat. Bot.; 14: No. 4, 257-262(Dec 1974).

Mecheast-22 cultivar tomato seeds were irradiated with 250 to 1000 rad doses of ^{60}Co gamma rays and the germinated seedlings transplanted to individual pots and grown in a greenhouse. The number of flower clusters, buds, and open flowers were scored at 25, 45, 70, and 90 days after transplanting. Radiation caused earlier and increased flower cluster formation, possibly by stimulating a still unknown mechanism that initiated the change from vegetative to generative growth. At D45, all doses increased the number of flower clusters, 500 and 750 rads giving significant increases. This increase was maintained throughout the experiment. Most of the extra clusters were located along the side stems. All radiation treatments gave significantly more open flowers at the beginning of the flowering period. The 500 and 750 rad doses significantly increased the number of buds at 45 days, and of open flowers at 70 days after transplanting, the latter amounting to 6 to 6.5 extra flowers per plant. The mean number of flower buds or flowers per cluster and the percentage of clusters without flowers were not affected by radiation. The radiation treatments did not significantly affect the vegetative development of the plants, although there was a slight trend towards increased tillering at 500 to 1000 rads. (auth)

1083 POSSIBLE CORRELATION BETWEEN AGEING AND IRRADIATION DAMAGE IN RICE. Bagchi, S. (National Inst. of Genetics, Mishima, Shizuoka, Japan). Radiat. Bot.; 14: No. 4, 309-313(Dec 1974).

The germinability of aged seeds differed conspicuously among rice varieties. Varieties with high and low germinability in aged seeds also showed high- and low-resistance for both the characters of germinability and seedling height, when their freshly harvested seeds were irradiated by gamma rays. (auth)

1084 EFFECTS OF CHRONIC GAMMA RADIATION ON THE COMPOSITION OF THE HERB COMMUNITY OF AN OAK–PINE FOREST. Flaccus, E.; Armentano, T. V.; Archer, M. (Brookhaven National Lab., Upton, NY). Radiat. Bot.; 14: No. 4, 263-271(Dec 1974).

A complete inventory of the herb populations of the inner 50 m of the Brookhaven irradiated forest was made in 1968 and 1973. The data were compared with those of earlier inventories, giving information on changes through a ten-year period in a community exposed to chronic radiation stress. Per cent cover of Carex pensylvanica, which dominated the zone 20 to 40 m from the source (125 to 25 R/day in 1973), increased rapidly at first and then more slowly through 1968, then declined somewhat by 1973. There was no shift in its distribution over ten years. Sharp increase in Rubus spp. cover in this zone contributed to the most recent Carex decline. A greater than eight-fold rise in total density of species other than Carex occurred since 1968, mostly due to a large increase in density of important species, while only those of infrequent occurrence declined or disappeared by 1973. Rate of change in herb populations was slowed by high exposures close to the source and by competition with Carex and Rubus in the sedge zone. The distribution of Rumex acetosella changed in a manner suggesting possible genetic alteration of radiosensitivity. There was a net increase of four species between 1968 and 1973. Species diversity increased with distance from the source, increased with time from 1968 to 1973 in the outer 40 to 50 m zone, and changed relatively slowly with time in the inner zones of higher exposure rates. The reasons for the comparatively slow rates of successional change are discussed. We predict that with future reduction in radiation stress due to source decay and with continuing expansion of Rubus spp. clones, Carex dominance will continue to decline as species diversity and herb population densities increase slowly. (auth)

1085 EFFECT OF SIMULATED DEW ON FALLOUT RETENTION AND BETA RADIATION DAMAGE TO A BEAN CROP. Schulz, R. K.; Ulrich, J.; Babcock, K. L. (Univ. of California, Berkeley). Radiat. Bot.; 14: No. 4, 273-279(Dec 1974).

A beta-emitting fallout simulant (very fine sand labeled with varying levels of ^{90}Y) was applied to a field bean crop (Phaseolus vulgaris L.). The foliage was wet or dry in alternate rows at time of application, thus simulating presence or absence of dew conditions. The presence of moisture caused a much larger initial retention of the simulant by the foliage. Dosimetry indicated that the contact dose under moist conditions was substantial, with the wet plants receiving a total dose 60 per cent greater than the dry plants. The yield of string beans was very sensitive to beta radiation and a dose of about 1000 rads to the surface of the apical buds severely reduced the string bean yield. It was estimated that this corresponded to a dose of about 400 rads to the meristematic tissue of these buds. Vegetative growth was much more resistant to the radiation with serious vegetative yield reductions occurring at about 10,000 rads to the surface of the apical buds. (auth)

1086 GENETIC CONTROL OF PHOTOMORPHOGENESIS. Isolation of Nonfilamentous Mutants After Gamma Irradiation of Pteridium Aquilinum Spores. Howland, G. P.; Boyd, E. L. (Oak Ridge National Lab., TN). Radiat. Bot.; 14: No. 4, 281-285(Dec 1974).

Photomorphogenetic mutants of Pteridium aquilinum gametophytes were isolated after exposure to gamma rays. The procedure involved screening large numbers of treated spores for their ability to form macroscopically visible prothalli when cultured in the absence of blue light (normally required for prothallial growth). Two hundred and eighty presumptive nonfilamentous mutants were isolated and thirty-nine actively growing strains were tested for expression of the mutant phenotype. The 20 stable mutants thus obtained will provide material for further genetic characterization of the photomorphogenetic process in fern gametophytes. (auth)

1087 EFFECT OF GAMMA IRRADIATION ON THE IODOLE ACETIC ACID SYNTHESIZING SYSTEM AND ITS SIGNIFICANCE IN SPROUT INHIBITION OF POTATOES. Ussuf, K. K.; Nair, P. M. (Bhabha Atomic Research Centre, Bombay). Radiat. Bot.; 14: No. 4, 251-256(Dec 1974).

Gamma irradiation interfered with the synthesis of the IAA synthesizing system and exogenous application of 20 ppm IAA within 6 hr after irradiation, triggered the synthesis of this enzyme. This fact was ascertained by the inhibition with protein synthesis inhibitors such as actinomycin D, puromycin, and cyclohexamide, on the recovery of enzyme activity on treatment with IAA. Irradiation accelerated the degradation of the existing enzyme by activation proteolytic activity. The IAA in irradiated potatoes was completely depleted and this was associated with the activation of H_2O_2 dependent IAA oxidase. A 50% decrease in the level of tryptophan, the substrate for IAA synthesis, was observed at 24 hr after irradiation. (auth)

1088 MUTATIONS INDUCED IN RED GRAM (CAJANUS CAJAN (L) MILLSP.) BY GAMMA RADIATION AND EMS. Khan, W. M. A.; Veeraswamy, R. (Agriculture Coll. and Research Inst., Coimbatore, India). Radiat. Bot.; 14: No. 4, 237-242(Dec 1974).

The seeds of Co. 1 red gram (Cajanus cajan (L) Millsp.) were treated with gamma rays (0, 14, 16, 18, 20, 22, 24, and 26 kR) and EMS (0, 60, 70, and 80 mM for 4 hr at room temperature) and observations were recorded in the M_1 and M_2 generations. The chlorophyll mutations in M_2 were maximum at 24 kR of gamma rays and 70 mM of EMS, but the maximum frequency of viable mutations was noted around 16 kR and 60 mM. The percentage of viable mutations was found to be greater for gamma ray treatments compared to those for EMS. Some morphological mutants have been reported for the first time. (auth)

1089 EFFECT OF RECURRENT MUTAGEN SEED TREATMENTS ON MUTATION FREQUENCY AND COMBINING ABILITY FOR FORAGE YIELD IN PEARL MILLET (PENNISETUM AMERICANUM (L.) K. SCHUM). Burton, G. W.; Powell, J. B.; Hanna, W. W. (Agricultural Research Service, Tifton, GA). Radiat. Bot.; 14: No. 4, 323-335(Dec 1974).

The effects of three cycles of recurrent seed treatment with thermal neutrons (TN), ethyl methane sulfonate (EMS), and diethyl sulfate (DS) on mutant frequency and combining ability in pearl millet (Pennisetum americanum (L.) K. Schum., formerly P. typhoides) were studied for eleven years. TN seed treatments gave the highest percentages of M_1 striped plants, the lowest percentage of M_1 selfed seed set, and the highest M_2 frequency of chlorophyll-deficient seedlings of the mutagens tested. Combining a low dose of EMS or DS with high and low TN treatments generally increased these effects. Normal lines, which looked like the controls, selected from lines subjected to three cycles of mutagen treatment, were compared with controls in 3×3 or larger Design II hybrid matings in 9×9 forage-yield trials. The 1,637 single-crosses between normal lines from mutagen treatment failed to exceed the 825 control singlecrosses in average forage yield or highest forage yield. These results suggest that pearl millet has many specific-yield genes, none of which exerts a very great effect on yield. Genetic variances estimated from the Design II diallels were not significantly altered by mutagen seed treatment. The EMS treatments increased the percentage of non-additive genetic variance over that in the control and TN treatments, but the failure of any of the 486 hybrids from EMS lines to outyield the best control hybrid suggested that these variance estimates might not be significant. The study suggests that attempts to improve the combining ability of inbred lines of pearl millet by mutagen treatment without several cycles of recurrent selection are not likely to succeed. (auth)

1090 RESPIRATION RATES OF RED PINE ALONG A GRADIENT OF GAMMA RADIATION FOLLOWING EIGHT YEARS

OF EXPOSURE. Jordan, C. F. (Argonne National Lab., IL). Radiat. Bot.; 14: No. 4, 337-341(Dec 1974).

Eleven-year-old red pine trees that had lived for eight years along a gradient of gamma radiation changed little in respiration rates between exposure rates of 1.0 to 4.0 rads/day. Between 4.0 and 6.0 rads/day, respiration rates increased by an average of 54%, and between 6.4 and 6.8 rads/day respiration rates decreased by an average of 26%. The increase in respiration rates may be due to oxygen consuming repair mechanisms. The decrease in respiration rates may result from reduced rates of cell division or reduced activity of growth hormones. The decrease probably did not result from dead tissue comprising part of the sample. (auth)

1091 CYTOKININS AND MITOTIC INHIBITION IN GAMMA-PLANTLETS. Jordan, W. R.; Haber, A. H. (Univ. of Tennessee, Oak Ridge). Radiat. Bot.; 14: No. 4, 219-222(Dec 1974).

After irradiation of dry grains with 500 krads of gamma rays, the cytokinin content of wheat seedlings germinating without cell division rose from a barely detectable quantity in the dry grains to an amount similar to that in seedlings from unirradiated controls. The chromatographic mobility of the cytokinins from the two sources suggested that they were identical. Treatment of the gamma-plantlets with cytokinins and several combinations of other growth substances failed to induce cell division. Accumulation of extractable cytokinins can be uncoupled from cell division and that failure of cell division in gamma-plantlets is not due to a gross deficiency of extractable cytokinins. (auth)

1092 SPECIFIC EFFECTS OF LOW DOSES OF IONIZING RADIATIONS ON SEED OF CULTIVATED PLANTS. Degner, W.; Schacht, W. (Humboldt Univ., Berlin). Radiobiol.-Radiother.; 15: No. 6, 661-667(1974). (In German).

It could be demonstrated in parcel experiments over several years that there is at least one absorbed dose in the application of ^{60}Co gamma radiation leading to increased crops for all species of silo maize when the dry seed is irradiated under defined conditions. For an absorbed dose rate of 25 rad/min the most favorable absorbed dose is 200 rad. A second dose, 50 rad, can also be taken into consideration for technical reasons for several species as WIR 25, Siloma, and Bukowinski 111 TW. An average increase in the crop of 10% with 50 rad and of 15.5% with 200 rad over several years and for different species results from fluctuations depending on year as well as on species. Obviously only in exceptional cases for individual species a radiation stimulation did not appear due to extreme outer conditions of growth. The remaining minimum increased crop, however, is for the most species so high (>5%) that irradiation is still leading to an economic profit. Furthermore, it could be demonstrated that spadix crop is more increased by an irradiation with 50 rad than leaf and stalk yield. A calculated ratio of 2.6:1 between spadix and remaining plant increase for the dose of 50 rad over several years and different species additionally offers a better forage quality besides highter total crops. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 744, 761, 778, 1190, 2129, 2132, and 2924.

1093 (AD-786180) MILITARY FIELD SYSTEM FOR INTRAORAL FLUOROSCOPY AT LOW LEVEL X-RAY EXPOSURES. Final Report. Savara, B. S.; Irwin, J. W.; Parker, W. L. (Oregon Univ., Portland (USA). Biophysics Lab.). 25 Sep 1973. Contract DADA17-67-C-7168. 23p. NTIS $3.25.

An intraoral fluoroscopy system has been designed and developed under U. S. Army sponsorship. The system provides real-time and instant replay x-ray images at a radiation exposure on the order of 500 times less than that required for exposure of a dental x-ray film. Radiation reduction is accomplished by use of an electronic image intensifier and a video disk recorder with stop action capability, while the intraoral application is made possible by use of a coherent curved fiber optic bundle with a phosphor on its input face. The system is portable. U. S. Patent No. 3,622,785 for this system was issued in November, 1971. (auth)

1094 (AD/A-002580) AIR FORCE TECHNICAL OBJECTIVE DOCUMENT: AMD FISCAL YEAR 1976. Final Report. Douthit, T. D. N. (Aerospace Medical Div., Brooks AFB, Tex. (USA)). 16 Dec 1974. 43p. (AMD-TR-74-1). NTIS $3.75.

The document describes the planning methodology used within the aerospace medical division (AMD) laboratories' five technology areas. Efforts were directed in the biotechnology program to man's adaptability, survivability, and performance capabilities within his operational environment. The research and development of AMD's functions is accomplished as disciplinary work by teams of biomedical scientists, engineers, and physical scientists within the Air Force laboratories and the industrial and academic research and development communities. (GRA)

1095 (AED-CONF-74-557-001) INFLUENCE OF ENERGETIC RADIATION ON THE BINDING CAPACITY OF THE EPIDERMIS FOR ANTI-BASAL MEMBRANE ANTIBODIES IN-VITRO. Remy, W.; Bockendahl, H. 1974. 4p. (In German). INIS.

From 2nd annual meeting on dermatological research; Duesseldorf, F. R. Germany (15 Nov 1974).

Available from ZAED.

The generation of fresh histological and immune optical change due to uv-radiation in patients with pemphigus vulgaris and pemphigoid is known from the literature. An exacerbation of the syndrome in two patients suffering from bullous pemphigoid was also observed after irradiation with radiocobalt or betatron rays, respectively. In-vitro experiments with pre-irradiation of the epidermis of healthy persons with 7,000 or 8,000 r showed an increase in the binding capacity of antibasal membrane antibodies by 2 to 3 titre levels. This effect could likewise be achieved by uv-irradiation, leading to an increase by 3 to 4 titre levels. (GE)

1096 (INIS-mf-1695) RADIATION HEALTH AND SAFETY. Annual Report for the Year Ended 31st December 1973. Rosen, R. (New South Wales Univ., Kensington (Australia)). 1974. 14p. INIS.

Aspects of the radiation health and safety at the University of N. S. W. are reviewed for the year 1973. These include personnel monitoring, radioactive waste disposal, licences, purchase and transfer of radiation sources, radiation insurance, investigations and reports on school projects, and a summary of radiation accidents during the year. (INIS)

1097 (PB-237522) RADIOLOGICAL HEALTH ASPECTS OF AGENTS MODIFYING THE BIOLOGICAL EFFECTS OF RADIATION. (Federation of America Societies for Experimental Biology, Bethesda, Md. Life Sciences Research Office). Jun 1969. 54p. NTIS $4.25.

The study summarizes and critically evaluates research on agents modifying the biological effects of radiation related to public health interests. The review includes the classes of agents that have been employed in the modification of the biological effects of radiation, their mechanisms of action, comparative effectiveness, and toxicity, the methodology used in evaluating thse agents, and their effectiveness against various radiation exposures. The conclusions of the report identify a general order for priority for future research. (GRA)

1098 (SAAS-167) RECOMMENDATIONS ON EXCLUSION FROM WORK WITH IONIZING RADIATION FOR MEDICAL REASON. Schuettmann, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Sep 1974. 39p. (In German). Dep. NTIS (US Sales Only) $5.00.

After detailed introduction into medical problems in relation to radiation protection and into the tasks of the responsible medical officer, the organ systems most important with regard to fitness evaluation are reviewed. The effects of certain diseases of these organs on fitness are described thus giving the responsible medical officer guidance in deciding whether a person can become or continue to be a radiation worker. (auth)

1099 (SCP-2.28.01-1) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT. Prospective Site: Skjoettelvik (Hurum). Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). Jun 1974. (In Norwegian). Dep. NTIS (US Sales Only) $6.75.

Atmospheric dispersion is calculated on the basis of meteorological data for the Skjottelvik (Hurum) prospective nuclear power plant site on the Oslofjord. Releases of radioactive materials from both BWR and PWR type reactors under normal operation and following loss of coolant accidents (two for each reactor type, corresponding to different assumptions of conditions following the accident) together with population data are then used to calculate the resulting radiation doses. Population doses under normal operation with a stack height of 100 m are, for a BWR 1.7 manrem/yr based on the 1972 population statistics and 2.4 manrem/yr based on the population prognosis for 2000. Corresponding doses for a PWR are 0.31 manrem/yr and 0.44 manrem/yr. Following a loss of coolant accident, using the meteorological data as prescribed in the US guidelines the individual doses for two different conditions are, for a BWR, two-hour dose at 1 km, whole body 0.51 rem and 0.02 rem and thyroid

1.0 (adult) and 0.13 (child), 30 day dose at 3 km, whole body dose 1.6 rem and 0.12 rem and thyroid dose 4.8 rem (adult) and 3.8 rem (child). The corresponding doses for a PWR are virtually the same. (NO)

1100 MEASUREMENTS FOR DETERMINATION OF THE BEHAVIOR OF FAST ELECTRONS OF DIFFERENT ENERGIES IN THE IRRADIATION OF HUMAN BONES. Kiefer, R. Hamburg, Ger.; Univ. Saarlandes (1973). 25p. (In German). INIS.

Thesis.

A human femur was irradiated with fast electrons. Both the position of the femur and electron energy were varied. The measured results are shown in tables and diagrams. With electron energies in the range from 20 to 30 MeV, a maximum dose loss was found in the half-depth as well as in the full-depth range. (GE)

1101 COBALT-60 TELETHERAPY OF THE PARAAORTIC LYMPHATIC SYSTEM. Dose Measurements With Standing Fields. Berner, H. Muenster, Ger.; Univ. Muenster (1973). 66p. (In German). INIS.

Thesis.

The paraaortic lymphatic system of a new phantom consisting of body-like organic polymers is irradiated with telecobalt-60 radiation by means of standing field irradiation. The experimental results are given in tables and isodose curves. It is shown that the tumor dose depends not only on the distance between radiation source and skin and on the depth of the convergence point but also on the position of the central beam and from the field dimension. (GE)

1102 SYSTEMATIC INVESTIGATIONS OF ECCENTRIC CINEROENTGENOTHERAPY WITH 42 MeV PHOTONS FROM A SIEMENS-BETATRON. Wilhelm, U. Homburg, Ger.; Univ. Saarlandes (1972). 39p. (In German). INIS.

Thesis.

With an oval plexiglass-water phantom, systematic investigations on eccentric pendulum irradiation with 42 MeV photons from a Siemens betatron were carried out. The axis of rotation was in a depth of 10 cm from the phantom surface and 9 cm lateral distance from the center of the phantom. The field extension varied from 6 × 12 cm, 8 × 12 cm, 10 × 12 cm to 12 × 12 cm. The pendulum angle was in all cases 180° (±90° on both sides). The isodose curves are given and discussed. (GE)

1103 RADIATION-HYGIENIC BASIS UNDERLYING EXPOSURE CONDITIONS IN MEDICAL ROENTGENOGRAPHY. Prostyakova, M. A.; Frolov, N. V.; Lyubomirskaya, A. M.; Stavitskii, R. V.; Khutoretskii, M. B. Vestn. Rentgenol. Radiol.; No. 1, 75-78(1975). (In Russian).

Experimental studies were carried out on the x-ray unit at 50 to 100 kV, with different fields and different object depth, with the aid of Va-I-18 apparatus. Exposure (in milliamperes per sec) for obtaining 4 mR in the set point providing the set quality of x-ray image (from positions of the necessary optic density, of x-ray film darkening) was determined by dosimetry data. The surface dose received by the patients under these conditions was calculated. Data are presented. Curves, of dependence of exposures and surface exposure doses on voltage, were drawn. With the aid of the curves it is possible to choose the optimal regimen for x-ray examination with the minimal radiation load for the patient. (auth)

1104 SERUM IMMUNOGLOBULIN LEVELS IN HUMANS EXPOSED TO THERAPEUTIC TOTAL-BODY GAMMA IRRADIATION. Chaskes, S.; Kingdon, G. C.; Balish, E. (Oak Ridge Associated Universities, TN). Radiat. Res.; 62: No. 1, 145-158(Apr 1975).

Reduced serum immunoglobulin (IgA, IgG, IgM) levels developed in the majority of 27 patients with hematologic disorders after treatment with 100 to 350 R total-body gamma-ray exposures at a dose rate of either 1.5 R/min to 1.5 R/hr. A reduction in IgA of 20 percent or more was found in 66 percent of the cases, while 56 percent showed an IgM decrease, and 49 percent an IgG decrease of 20 percent. The severity of immunoglobulin depression was influenced by the total radiation dose and the patient's primary disease. The occurrence of IgG and IgM depression was greater when the radiation was given at 1.5 R/hr than when the dose rate was 1.5 R/min. Substantial but incomplete recovery toward preirradiation immunoglobulin levels was found for most patients by 7 wk after total-body irradiation (TBI). (auth)

1105 FRAGILE OZONE LAYER: A NEW ENVIRONMENTAL TIME BOMB. Olivero, J. J. (Pennsylvania State Univ., University Park). Earth Miner. Sci.; 44: No. 4, 25-30(Jan 1975).

The role of ozone as a shield against the harmful effects of ultraviolet radiation on living things is discussed. Studies on the effects of supersonic transport on atmospheric ozone are reviewed. It is pointed out that rockets of the future will deposit large quantities of HCl into the atmosphere; this will be decomposed by ultraviolet radiation to chlorine which will destroy the ozone. The dangers of nuclear weapons tests in reducing ozone in addition to the destructiveness of radioactive fallout are discussed. (HLW)

1106 PIONEER 10 JOVIAN ENCOUNTER: RADIATION DOSE AND IMPLICATIONS FOR BIOLOGICAL LETHALITY. Miller, M. W.; Kaufman, G. E.; Maillie, H. D. (Univ. of Rochester, NY). Science; 187: No. 4178, 738-739(28 Feb 1975).

In its recent Jupiter flyby Pioneer 10 passed through a belt of intense particulate radiation. The radiation dose on the outer surface of the spacecraft was at least 4.9×10^5 rads from electrons plus 2.9×10^6 rads from protons, sufficient to cause significant microbial decontamination. The radiation dose inside Pioneer 10, approximately 2.8×10^5 to 4.9×10^5 rads, was less likely to cause microbial decontamination but would be lethal to man and to most multicellular biological organisms. (auth)

1107 QUANTITATIVE NUCLEAR MEDICINE IMAGING: APPLICATION OF COMPUTERS TO THE GAMMA CAMERA AND WHOLE-BODY SCANNER. Budinger, T. F. (University of California, Berkeley). pp 41-130 of Recent Advances in Nuclear Medicine. Volume IV. Lawrence, J. H. (ed.). New York; Grune and Stratton, Inc. (1974).

The following topics are reviewed: properties of computer systems for nuclear medicine quantitation; quantitative information concerning the relation between organ isotope concentration and detected projections of the isotope distribution; quantitation using two conjugate views; three-dimensional reconstruction from projections; quantitative cardiac radioangiography; and recent advances leading to quantitative nuclear medicine of clinical importance. (HLW)

1108 EPIDEMIOLOGIC STUDIES OF CORONARY HEART DISEASE AND STROKE IN JAPANESE MEN LIVING IN JAPAN, HAWAII, AND CALIFORNIA: DEMOGRAPHIC, PHYSICAL, DIETARY, AND BIOCHEMICAL CHARACTERISTICS. Kagan, A. (National Heart and Lung Inst., Honolulu, HI); Harris, B. R.; Winkelstein, W. Jr.; Johnson, K. G.; Kato, H.; Syme, S. L.; Rhoads, G. G.; Gay, M. L.; Nichaman, M. Z.; Hamilton, H. B.; Tillotson, J. J. Chron. Dis.; 27: 345-364(21 May 1973).

These summary descriptive data of ethnically similar cohorts of indigenous and migrant Japanese males have shown similarities or slight differences in characteristics wholly or largely genetically determined, such as blood groups, stature, and skeletal size. Differences have been noted in characteristics largely environmental or behavioral, such as diet and cigarette smoking habit, as well as in characteristics determined by a varying mixture of genetic and environmental influences, such as weight, blood pressure, glucose tolerance, and serum lipid and uric acid levels. Detailed analyses of the distributions of laboratory variables, of dietary data obtained by different methods, and of correlations among laboratory, dietary, physical, and demographic variables are currently in progress. Also part of the study plan are determinations of disease prevalence from evaluation of examination, laboratory, and electrocardiographic findings, of disease incidence from repeat examinations and from surveillance of hospital records, and of cause-specific mortality from hospital records, and from death certificates. In addition, at Hiroshima and Honolulu a uniform autopsy protocol is in use. All of these disease findings will be correlated with characteristics determined by questionnaire, interview, examination, and laboratory analyses in order to determine the relations between the measured variables and the occurrence of CHD and stroke. (auth)

1109 DETECTION AND EVALUATION OF LOCALIZATION ERRORS IN PATIENT RADIATION THERAPY. Haus, A. G.; Marks, J. E. (Univ. of Chicago). Invest. Radiol.; 8: No. 6, 384-391(1973).

From 21st annual meeting of the Association of University Radiologists; Vancouver, B. C. (10 May 1973).

In the radiotherapeutic treatment of patients, inability to irradiate the entire diseased area consistently and accurately can result in local failure or improper control of disease. Since 1969, a film technique developed for imaging of the complete patient radiation exposure has been applied to evaluate localization errors occurring in the radiotherapy department. The technique basically involves placing a film with good image quality, proper sensitivity and contrast in the exit-dose exposure ranges encountered in radiotherapy, under the patient during the entire radiation exposure. In the evaluation of the film a localization error was noted when portions of the diseased area were not properly included in the treatment field, or when an excessive region of normal tissue was improperly shielded. Examples from an investigation are shown

whereby verification films were taken for every treatment in 5 selected cases, including 3 patients treated with extended mantle fields and 2 treated with pelvic fields. In this study, 62 out of 206 treatments showed localization errors. For the extended mantle fields in this study, if a localization error occurred, it was usually propagated throughout the treatment. The main goal in reducing errors in radiation therapy is to provide optimum treatment for the patient. (auth)

1110 TERMS AND DEFINITIONS IN THE FIELD OF RADIOLOGICAL TECHNIQUE. Radiation Protection. pp DIN 6814, B1.5 of German Norms. Berlin, F. R. Germany; Beuth (Apr 1972). (In German).

Loose-leaf binding.

The scope of radiation protection and health physics measures include: radiation effects and radiation exposure; biological terms and terms used in dosimetry; biological limiting values, maximum permissible doses, activities, and concentrations; persons to be controlled; areas to be controlled and surveyed; and tasks to be fulfilled by radiation protection surveillance and measures to be taken. (GE)

1111 DOSE DISTRIBUTION AND IRRADIATION TECHNIQUE IN RADIOTHERAPY OF BREAST CANCER STAGE I. Wuerthner, K.; Seeger, W. (Hamburg Univ. (F. R. Germany). Strahlenabteilung). Strahlentherapie; 149: No. 1, 29-40(Jan 1975). (In German).

A method for homogeneous irradiation of the breast by means of opposite standing fields, with the use of wedge filters, is described. The field is focussed so that the interior thoracic wall under symmetric position of the mamma is still completely situated in the irradiation field, and the lateral area of the radiation beam passes 1 to 2 cm into the pulmonary tissue. On a series of typical breast models, made under consideration of the irradiation position, the isodose distributions were determined by film-dosimetry. The therapeutically most important 80%-isodose corresponds in practically every case with the mamma contour. Peak doses or areas of underdosage were not observed. The thoracic wall is still exposed to about 75% of the maximum dose. In order to obtain a more accurate irradiation by the desired maximum dose of, for example, 250 R, the deviation of which does not exceed ± 7%, it is necessary, at the beginning of an irradiation series, to use ionization chamber measurements with an intensifying hood on the surface of the mamma, 1.5 cm above the border of the field. In the case of lateral irradiation, the measurement need only be made laterally in medial irradiation it is only necessary on the medial side. The portion of the dose affecting the opposite field on the measuring place can be calculated by the use of depth dose tables. From the values so gained the desired maximum dose within the mamma may be ascertained by multiplication by the factor 1.03. (auth)

1112 OPTIMIZATION OF IRRADIATION PLANNING IN DEEP THERAPY. An Outline of the Chance of [illegible]urvival of the Tumor Patients. Popp, F. A. (Marburg Univ. [illegible]. R. Germany). Inst. fuer Strahlenkunde). Strahlentherapie; 149. No. 1, 93-102 (Jan 1975). (In German).

Simple model conceptions are used for the demonstration of the chance of survival of tumor patients. The systematic judgment of the therapy is possible after the adaptation to known survival curves for patients in different stages. The ascertainment of the tumor duplication period for primary tumor and—on principle—also for metastases, permits conclusions on the recuperative capacity and radioresistance of the exposed normal tissue and of the tumor. It was seen that the values found can lie in the range of the data known from radiobiology. Vice versa, it is possible in principle by means of derived relation to optimize dose distribution, fractionation, and total dose in radiotherapy. Moreover, the systematic analysis of the known survival curves of tumor patients within the frame of model conception allows the expectation that also influences therapy on the tumor duplication time, and possibly the dissemination capacity of the tumor, can be analyzed. These values reflect the tumor-host relations and seem to be of decisive significance for future successful concepts of therapy. (auth)

1113 TERMS AND DEFINITIONS IN THE FIELD OF RADIOLOGICAL TECHNIQUE. Dose quantities and units. pp DIN 6814, B1.3 of German norms. Berlin, F. R. Germany; Beuth (Jun 1972). (In German).

General definitions of terms such as energy transferred to material, energy dose, energy dose rate, kerma, kerma rate, secondary electron equilibrium, Bragg-Gray conditions, ion dose, ion dose rate, characteristic dose rate, specific gamma-ray constant; and definitions of special terms in nuclear medicine, namely: tissue surface dose, focal dose, isodose surfaces and isodose curves, dose product per unit area; finally special dose concepts in radiation protection and health physics; equivalent dose, personal dose, local dose and local dose rate are given. (GE)

1114 POSSIBILITIES OF REDUCING THE RADIATION EXPOSURE RISK ASSOCIATED WITH X-RAY DIAGNOSTICS. Stieve, F. E. (Bundesgesundheitsamt, Berlin (F. R. Germany). Abt. fuer Strahlenhygiene). Bundesgesundheitsblatt; 17: No. 25/26, 394-401(Dec 1974). (In German).

Many of the risks associated with the use of x rays have become evident only in the last few years due to the results of investigations on the effects of nuclear explosions in Japan. A great part of the so-called somatic stochastic changes occurred only after a certain latency period. Therefore, possible effects on persons caused by x-ray diagnostics can be prevented by reducing the radiation exposure to the necessary level. This can be achieved by means of a precise indication for the examination and a skillful performance; in this connection, considerations concerning the examination and application techniques also play an important part. (GE)

1115 COMPUTATIONAL METHODS IN BEAM THERAPY PLANNING. van de Geijn, J. (H. Joannes de Deo Hospital, The Hague). Comput. Programs Biomed.; 2: No. 3, 153-168 (Apr 1972).

In radiotherapy, beams of high energy photons are used to deliver doses of absorbed energy to specified volumes in patients. Such doses must satisfy certain requirements as to distribution and level. The planning of radiation treatment is a complicated process due to the physical and geometrical aspects of both the radiation beams and the patient. A brief survey is given of conventional planning means and methods and their limitations, followed by a description of objectives and implications of computer methods in this field. Computer-assisted beam treatment planning involves controlled interaction of two mutually dependent models: the patient model and the beam model. Simulation of 2-D and 3-D dose distributions corresponding to techniques as proposed by the radiotherapist is discussed. The patient model is generally one or more sets of numbers representing one or more 2-D contours. Four types of beam models are discussed: the 2-D matrix (digitised isodose chart); "generating functions"; the decrement line model; and a model based on the separation of primary and scatter dose. These models are considered as to their basic form. Extensions related to the actual patient conditions and the need for modifications of the basic beam conditions are treated separately. The survey is concluded by some observations about possible criteria for meaningful comparison of the merits of beam models and computer programs for clinical purposes. (auth)

1116 MEDICAL X-RAY EQUIPMENT UP TO 300 kV. Radiation Protection Rules for Installation. Draft. pp DIN 6812 of German Norms. Berlin, F. R. Germany; Beuth (Feb 1974). (In German).

Contents of this proposed standard include: validity; maximum permissible dose; general rules for the design of x-ray equipment; performance data and mode of operation; calculation of shielding layers required; additional constructional radiation protection measures; symbols to be used; radiation protection documents; diagrams and tables; and compilation of calculational methods for determination of shielding layers for protection from useful and parasitic radiation. (GE)

1117 BODY PORTION SUPPORT FOR USE WITH PENETRATING RADIATION EXAMINATION APPARATUS. Hounsfield, G. N. (to EMI Ltd.). US Patent 3,867,634. 18 Feb 1975. Priority date 23 Aug 1968, United Kingdom of Great Britain and Northern Ireland. 14p.

Apparatus is disclosed for examining a body by means of radiation such as x or gamma radiation. The body to be examined is surrounded by a liquid such as water and is protected therefrom by means of a flexible member which surrounds the body. In the event that the body comprises the skull of a human patient, the flexible member is conveniently formed as a hat, and means are provided for holding the patient in a desired disposition with respect to the apparatus during the examination. (Official Gazette)

1118 THE VOLUME FACTOR IN RADIOTHERAPY. The Significance of the Tissue or Tumor Volume for Evaluating the Radiotherapeutic Effect. Busch, M.; Popp, F. A. (Marburg Univ. (F. R. Germany). Radiologiezentrum). Strahlentherapie; 149: No. 1, 75-92(Jan 1975). (In German).

The absorbed energy dose, in relation to the irradiated tissue volume or tumor volume (dose-volume-relations) has great significance for the valuation of radiation injuries and for the prognosis of the disease. An analysis, formal demonstrations, and interpretation of these relations are presented. Clinical

observations and radiobiological experiments in literature were the basis of the investigations. The assessment is kept simple, the models derived from it interpret well the clinical findings. Through these models, radiobiological findings and clinical experimental principles are connected. This results in a clear conception of the future development of irradiation planning, and the application technique of radiation. The range of validity of the cited models includes the treated volumes usual in radiotherapy. An extrapolation to the cellulary area or to the whole body may only be made with great reservations. (auth)

1119 RADIATION INJURIES. Devik, F. Tidsskr. Norske Laegforen.; 95: No. 8-9, 542-545(20 Mar 1975). (In Norwegian).

A major accident involving radiation injuries is a potential occurrence primarily at nuclear power plants, during transport of irradiated reactor fuel and at reprocessing plants. It is stated that external radiation due to release of radioactive materials is easily limited by cleansing. However, internal contamination may lead to delayed effects, and in this connection ^{89}Sr and ^{90}Sr, ^{131}I, ^{137}Ce, and ^{239}Pu in particular are briefly discussed. In the main part the discussion is limited to acute and subacute injuries and the symptoms of the radiation syndrome are presented. Patients are classified in five groups, according to clinical symptoms and dose magnitude, and their treatment described. A combination of radiation injuries with other injuries, can give synergism between the components, which has consequences for the treatment. Preparations and precautions to limit the consequences of an accident are then briefly discussed and guidelines for measures to be taken by command, health physics, and first aid groups are presented. In conclusion precautionary measures against the effects of nuclear weapons are discussed. (auth)

1120 EXPERIMENTAL AND THEORETICAL DOSIMETRIC STUDY OF ISODOSES IN THE TANGENTIAL PENDULUM TECHNIQUE APPLIED TO THE MAMMARY REGION IN TELECOBALT THERAPY. Dall'Acqua, R. (Instituto Radiologico dell'Ospedale Mauriziano, Turin); Lovera, G.; Filisetti, O.; Tedde, P. G. Nunt. Radiol.; 35: No. 10, 913-934(Oct 1969). (In Italian).

The isodose curves in various parallel sections located at different levels of the irradiated body were experimentally measured in a polyurethane resin phantom in order to obtain indications on the tridimensional dose distribution. Typical isodose curves obtained are shown. An analytical procedure was developed for the calculation of the isodoses which takes into consideration the continuous motion of the incident beam. (JSR)

1121 RADIOACTIVE RADIATION AND ITS EFFECT ON MAN. Aamlid, H. (Statens Inst. for Straalehygiene, Oslo). Ingenioer-nytt; 11: No. 9, 7-9(7 Mar 1975). (In Norwegian).

From conference on nuclear power: should we have doubts; Oslo, Norway (11 Feb 1975).

A brief presentation is made of the biological effects on man of ionizing radiation. The sources of such radiation, natural and artificial are summarized. The philosophy on which the maximum permissible doses to various groups and to the population are based is briefly described. Tables are given illustrating the various aspects discussed. (NO)

1122 NUCLEAR RADIATION AND HUMAN HEALTH. Sternglass, E. J. (Univ. of Pittsburgh). pp 121-179 of Against Pollution and Hunger. Notes Toward a New World. Hilton, M. A. (ed.). Oslo; Universitetsforlaget (1974).

From conference of the Society for Social Responsibility in Science; Trondheim, Norway (26 Aug 1971).

The evidence of rises in infant mortality, congenital defects, and childhood cancers associated with nuclear testing and similar rises in infant mortality in the vicinity of nine nuclear facilities known to give environmental activity levels comparable to nuclear weapons tests are discussed. The possibility exists that both infant mortality and chronic diseases for all ages having genetic components may have been more seriously affected by low-level environmental radiation than expected. A world-wide moratorium on the construction of nuclear power plants is advocated pending further statistical studies. (NO)

1123 ANALYSIS OF X-RAY-INDUCED CHROMOSOMAL TRANSLOCATIONS IN HUMAN AND MARMOSET SPERMATOGONIAL STEM CELLS. Brewen, J. B. (Oak Ridge National Lab., TN); Preston, R. J.; Gengozian, N. Nature (London); 253: No. 5491, 468-470(6 Feb 1975).

It is stated that one of the major classes of genetic damage produced by ionizing radiation is inheritable reciprocal translocation, and some studies are described on male marmosets and nine men. The marmosets were testicularly irradiated with doses of 25 to 300 R of 250 kV x rays, and at various intervals after irradiation, depending on the dose, bilateral castration was performed and preparations made. Biopsy material was obtained from the nine men, six of whom had received testicular x-ray exposures of 78 to 600 R, and preparations were made. Human and marmoset diplotene-diakinesis figures were analyzed for the presence of multivalent configurations which were the result of reciprocal translocations induced in spermatogonial stem cells. Results are shown in tabular form. Yields of dicentric chromosomes in peripheral leukocytes at the same doses are given in order that somatic against germ cell comparisons could be made. The data indicate that, as in the case of peripheral leukocytes, both man and marmoset are at least twice as sensitive to reciprocal translocation in spermatogonial stem cells as the mouse. The mean rate of reciprocal translocation induction in man and marmoset was estimated as 7.7×10^{-4} translocations per cell per rad. (UK)

1124 EVALUATION OF THE CHANGES IN THE BLOOD IN CANCER USING RADIATION-CHEMICAL METHODS. Sharpatyi, V. A.; Zakatova, N. V. (Inst. of Chemical Physics, Moscow). Biophysics (USSR) (Engl. Transl.); 19: No. 1, 192-194(Dec 1974).

Heparinized samples of blood or blood plasma from (a) normal rats, and normal human subjects and (b) rats with erythromyelosis (developed stage-9) and patients with chronic myeloid leukemia were mixed with freshly prepared potassium peroxylamine disulphonate (PADS), stored at 0°C for up to 30 min, and irradiated with accelerated electrons. Changes in the concentration of PADS with dose in the irradiated samples suggested that there is a competitive process for the products of radiolysis between PADS (a radical indicator) and either some substance produced, or some change, in the blood during disease. Substantial differences were recorded between the results for normal and pathological blood samples. It may be possible to use this technique to follow the course of development of disease. (UK)

1125 HISTOLOGICAL CHANGES IN CERVICAL LYMPH NODES FOLLOWING CLINICAL IRRADIATION. Burge, A. J. S. (Chatterick Military Hospital, Eng.). Proc. Roy. Soc. Med.; 68: No. 2, 77-79(Feb 1975).

From conference on significance and management of metastatic lymph nodes in the neck; Cardiff, Eng. (21 June 1974).

The practice of irradiating lymph node fields draining cancer sites so as to destroy microscopic tumor deposits in the nodes is widespread. However, any irradiation of neck fields is likely to irradiate many nodes not so involved. A survey of the relationship between histological changes and radiation doses in such uninvolved human cervical lymph nodes demonstrated that clinical irradiation had similar effects to single dose irradiation in animals. While it was not possible to estimate accurately the prior doses of irradiation from examinations of individual nodes, progressive changes with increasing doses could be seen, leading to loss of lymphoid tissue and replacement by fibrous tissue. Functional changes probably occur, resulting in loss of filtering power of the nodes and their by-pass anastomotic lymph channels. In view of the significance of the regional lymph nodes in the immune response to tumors, radiotherapy should be so devised that as much as possible of the immune mechanism may be left undamaged. (UK)

1126 RADIATION MYELOPATHY OF CERVICAL SPINAL CORD SIMULATING INTRAMEDULLARY NEOPLASM. Fogeholm, R.; Haltia, M.; Anderson, L. C. (Helsinki Univ.). J. Neurol., Neurosurg., Psychiat.; 37: No. 10, 1177-1180(Oct 1974).

Radiation myelopathy is a well-known complication of irradiation therapy of neoplasms in the vicinity of the spinal cord. The clinical and pathological findings in a case of cervical myelopathy after irradiation of hypopharyngeal carcinoma with a myelogram suggesting intramedullary neoplasm associated with an extremely high CSF protein concentration are reported. The irradiation consisted of ^{60}Co-therapy with a tumor dose of 6,000 R. Six months after myelography necropsy revealed severe atrophy of the previously thickened lower cervical spinal cord. The pathogenetic mechanisms are discussed. (UK)

1127 VISUAL EFFECTS ON EXPOSURE OF THE EYE TO COSMIC RAYS AND HIGH-ENERGY PARTICLES. Demirchoglyan, G. G. Biophysics (USSR) (Engl. Transl.); 19: No. 2, 314-319 (Jan 1975).

The problem of the effect of penetrating radiation on the retina of the eye is now highly topical in relation to the flashes observed in the eyes of astronauts in flights to the moon. This phenomenon is a new manifestation of the ultra-high radioexcitability of the retina. This phenomenon was examined in terms of experimental radiobiological investigation of the retina. The participation of the Vavilov-Cherenkov luminescence and the role of direct radioexcitation of the membranes of the photoreceptors in the phenomenon are discussed. (auth)

1128 PRODUCTION OF REIDER LYMPHOCYTES BY X IRRADIATION. Schrek, R. (Veterans Administration Hospital, Hines, IL). Int. J. Radiat. Biol.; 26: No. 6, 593-595(Dec 1974).

Irradiation of suspensions of normal human lymphocytes with 6000 rads x rays followed by incubation at 37°C or 27°C produced Rieder cells with lobed nuclei and many microtubules between the nuclear lobules. When vincristine, a drug which binds with microtubules, was added to the cell suspensions before irradiation, the formation of the Rieder cells was inhibited. These findings indicated that the microtubules were sensitive to irradiation with large doses of x rays. (UK)

1129 STUDY OF REPARATION OF CHROMOSOME DAMAGES IN NON-STIMULATED HUMAN PERIPHERAL BLOOD LYMPHOCYTES BY A FRACTIONATION METHOD AND A VARIATION OF TEMPERATURE. Elisova, T. V. (Inst. of Developmental Biology, Moscow). Genetika; 11: No. 2, 168-174 (Feb 1975). (In Russian).

The fractionation experiments were carried out on resting lymphocytes. Non-stimulated lymphocytes were x irradiated at the total dose of 200 R separated into two equal parts by either 5-hour or 20-hour intervals. The whole blood samples were kept during the intervals between the exposure at the temperature of 20° C or 37° C. All the cultures were made after the last radiation exposure at 37° C. Dicentrics and centric rings were scored. It is shown that a fractionation effect takes place in resting lymphocytes when the whole blood was kept for intervals between the half-dose at 37° C and is absent at the temperature of 20° C. It is suggested that there is the repair in lymphocytes at the stage G_0, at least, from the dose of 100 R. (auth)

1130 ADRENAL CORTEX FUNCTION IN COMBINED TREATMENT OF PATIENTS WITH PULMONARY CANCER. Kokina, L. P.; Medvedev, V. N.; Firsova, P. P. (Research Inst. of Medical Radiology, Obninsk, USSR). Vop. Onkol.; 21: No. 3, 7-10 (1975). (In Russian).

Ninety five patients with pulmonary cancer were investigated. In lung cancer a correlation of total 17-ketosteroids and 17-oxycorticosteroids is changed on account of decreased androgenic hormones and increased glucocorticoid hormones. A response to the operative trauma is not the same in different subjects. Following radiotherapy in most patients a reliable inhibition of the glucocorticoid function of the adrenal cortex was observed. (auth)

1131 BLAST-TRANSFORMATION OF PERIPHERAL BLOOD LYMPHOCYTES IN PATIENTS WITH CERVICAL CANCER DURING RADIOTHERAPY. Shirii, A. V. (Medical Inst., Lvov). Vop. Onkol.; 21: No. 3, 35-40(1975). (In Russian).

The blast-transformation of peripheral blood lymphocytes was studied in 60 patients with cervical cancer depending on the stage of radiotherapy applied. A progression of the tumor process reduces the capacity of peripheral blood lymphocytes for blast-transformation in the FHA stimulated culture. The radiotherapy would enhance a suppression of functional properties of T-lymphocytes. The use of the blast-transformation reaction seems to be possible for estimation of changes in the cellular immunity in oncological patients during radiotherapy. (auth)

1132 CONSERVATIVE TREATMENT OF PATIENTS WITH LUNG CANCER. Kas'yanenko, I.V. (Inst. of Oncological Problems, Kiev). Vop. Onkol.; 21: No. 3, 11-15(1975). (In Russian).

Four hundred inoperable patients with lung cancer of stage III and IV were given two or three chemical substances according to the schemes applied or one of cytostatics with telegamma therapy. Control patients were administered only cyclophosphan or subjected to telegamma therapy. The best immediate and late results were noted in subjects receiving either three substances or gamma-radiation with antimetabolites, 5-fluoruracil in particular. An efficacy of the treatment was estimated depending on the morphological structure of a tumor. A toxic effect of the therapy employed on the gastrointestinal tract and hemopoiesis was studied. (auth)

1133 ASSESSMENT OF RADIOLOGISTS' EXPOSURE TO X RAYS DURING CERTAIN SPECIAL RADIOLOGICAL EXAMINATIONS. Jankowsi, J. (Inst. of Radiation Medicine, Lodz, Poland). Pol. Przegl. Radiol. Med. Nukl.; 38: No. 6, 771-777(1974). (In Polish).

Using ionization chambers with measurement range from about 40 μR to about 20 mR the distribution of exposure dose was measured on the body surface of radiologists carrying out such examinations as angiography, arteriography, renal biopsy, aortography, cardiac catheterization, and coronarography. The exposure was greatest during renal biopsy and it was observed that the monthly exposure dose may be twice as high as the acceptable one. The remaining examinations carried out once daily were not associated with exposure to doses exceeding the acceptable ones. (auth)

1134 COMPUTER OPTIMIZATION OF COBALT TREATMENT PLANNING. Bourgat, J. F. (Institut de Recherche d'Informatique et d'Automatique (IRIA), Domaine de Voluceau, 78-Rocquencourt (France)); Rivier, M. (Paris-11 Univ., 91-Orsay (France)); Dutreix, A.; Bernard, D. (Institut Gustave Roussy, 94-Villejuif (France)). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 775-779(Nov 1974). (In French).

One of the problems set by radiotherapy is to irradiate sufficiently the tumor while protecting sensitive organs. The principle of a program that computes the number, the directions, and the contributions of cobalt 60 beams that respect given constraints as well as possible is outlined. The body, the tumor, and the organs are approximated by square meshes. The constraints are inequalities to be satisfied: on each tumor mesh; on each organ mesh; on entry meshes of beams axes, to avoid overdoses at beams entry points. The problem is expressed mathematically as a minimization of the function sum of the doses delivered to the organs under the above linear constraints. The problem is solved by a simplex method with a number of variables on the order of the number of meshes for which the constraints are set. Beams that contribute less than 5% to the treatment are eliminated from the final results. Isodose lines corresponding to the treatment defined by the selected beams are plotted automatically. The study was done in a cross section of the human body but the method could be extended to the tridimensional problem. (FR)

1135 SURVEY OF LUMINESCENT CLOCKS IN HOUSEHOLDS. Butler, H. M. (Oak Ridge National Lab., TN). Health Phys.; 28: No. 3, 299-301(Mar 1975).

A survey aimed at determining the population exposures from gamma-emitting luminescent material on clocks is reported. According to this survey, one of every three households has one clock that emits penetrating radiation. About half of these are in the bedroom, doubling the γ background for those exposed at two meters or less and yielding several times the natural background dose to the head in those cases where the clock is on or near the head of the bed. Using these very limited data it is concluded that the presence of luminescent clocks that emit penetrating rays is responsible for a 10% increase in the γ-radiation background to ~5% of the population. (UK)

1136 COMMENTS ON THE CONCEPTS OF BIOPHYSICAL DOSE AND DOSE RATE IN CONTINUOUS IRRADIATION. Momeni, M. H. (Univ. of California, Davis). Health Phys.; 28: No. 3, 307-308(Mar 1975).

Some of the problems that are deeply frustrating and plague most efforts for a relevant biophysical dose estimation to a continuous irradiation are discussed. These include the difficulties of spatial and time integration of dose rates and the problems associated with the cellular population. These difficulties are well known to the scientific organizations responsible for recommending values for maximum dose and they have judiciously assumed the linear model for risk assessment to the public as a prudent and feasible administrative approach. It is stressed that all presently available data on the radionuclide carcinogenetic effects and continuous exposures should be used for risk assessment instead of basing the analysis on an isolated phenomenon or a single group of phenomena. MPD and MPC values should come from the wealth of the experimental data from many species, ages, dose and dose rates, in vivo and in vitro studies. (UK)

1137 THERAPY OF RADIOCYSTITIS. Schwarz, R.; Retzke, U.; Fuertig, W. (Univ., Rostock, Ger.). Radiobiol.-Radiother.; 15: No. 6, 687-694(1974). (In German).

Report on a complex therapy of increased radiation responses of the urinary bladder following the radiological treatment of gynecological carcinomas. Aim of the treatment is to avoid irreversible damages to the bladder such as vesicovaginal fistula or shrunken bladder. As there is no causal therapy of radiation consequences a symptomatic treatment acting at different points is recommended. By physical measures (pelvic floor gymnastics, short-wave diathermy, wet stupe, electric cushion, hip-bathes, tar and mud packs) as well as by oestriol medication the blood flow of the organs of the small pelvis especially of the bladder wall shall be improved. The oral administration of antibiotics or chemotherapeutics serves the prophylaxis or therapy of infections of the urinary passages. Instillations with lidocain gel have analgesic effects. The intravesical instillation treatment with a "combined sulfisomidine slime," besides prednisolone (antiphlogistic and antiproliferative effect), lidocain (surface anaesthetic for alleviation), sulfisomidine (infection prophylaxis) also containing pantothenol and vitamin A for influencing epithelial reactions. Before this instillation treatment coatings and incrustations have to be removed. Instead of the useless mechanical curettage of the urinary bladder for necrosis removal the fermentative curettage with trypsin solution is recommended. (auth)

1138 MALIGNANT LYMPHOMA OF THE THYROID FOLLOWING IRRADIATION. Bisbee, A. C.; Thoeny, R. H. (Good

Samaritan Hospital, Phoenix, AZ). Cancer; 35: No. 5, 1296-1299 (May 1975).

A case of primary lymphocytic lymphoma of the thyroid is presented occurring in a 19-year-old woman. The young age of this patient, as well as the possibility of thymic radiation therapy as an infant, being a predisposing factor makes this case unique. The association with Hashimoto's thyroiditis has been previously reported. (auth)

1139 LOW-DOSE RADIATION PNEUMONITIS. Braun, S. R.; DoPio, G. A.; Olson, C. E.; Caldwell, W. (Univ. of Wisconsin, Madison). Cancer; 35: No. 5, 1322-1324(May 1975).

A case demonstrating fulminant radiation pneumonitis following a course of prophylactic whole lung irradiation at doses below 2000 rads, resulting in death, is presented. The importance of predisposing factors and the suspected sensitizing factor in this case are discussed. (auth)

1140 CLINICAL COURSE OF PATIENTS WITH SQUAMOUS CELL CARCINOMA OF THE UPPER RESPIRATORY AND DIGESTIVE TRACTS WITH NO EVIDENCE OF DISEASE 5 YEARS AFTER INITIAL TREATMENT. Kogelnik, H. D.; Fletcher, G. H.; Jesse, R. H. (Univ. of Texas System Cancer Center, Houston). Radiology; 115: No. 2, 423-427(May 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

Eleven hundred sixty-three patients with squamous cell carcinoma of the upper respiratory and digestive tracts, treated from January 1948 through December 1965, had no evidence of disease five years after the initial treatment and no other manifestations of squamous cell carcinoma within the first five years. After five years, the incidence of disease at the initial location, in the vicinity, or in remote sites was found to be identical in the surgical and irradiation groups. There is a correlation between severe late complications in the irradiated patients and the volume of tissue irradiated. (auth)

1141 EXPOSURE OF THE RADIOLOGIST TO SCATTERED RADIATION DURING ANGIOGRAPHY. Santen, B. C.; Kan, K.; Velthuyse, H. J. M.; Julius, H. W. (St. Elisabeth Hospital, Tilburg, Netherlands). Radiology; 115: No. 2, 450(May 1975).

At least 90 percent of the exposure of a radiologist's crystalline lens and right hand to scattered radiation during angiography, investigated by thermoluminescent dosimetry, proves to be due to radiography during and immediately after manual injection of the contrast medium. Therefore, manual injection should be replaced by remotely controlled injection by means of an injector. The exposure of a radiologist's gonads (measured behind a lead apron) proves negligible. At the low exposure rates to be expected, integrating measurements should be made. (auth)

Vertebrates

Refer also to abstracts 528, 1072, and 1204.

1142 (AD/A-003430) QUANTITATIVE CHANGES IN VASCULAR VOLUME OF IRRADIATED PRIMATE MANDIBLE: A FEASIBILITY STUDY. Final Report, January–June 1974. Bump, R. L.; Hardy, K. A. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Nov 1974. 10p. (SAM-TR-74-34). NTIS $3.25.

Sixty days following a cancercidal dose of radiation (5,600 rads), the vascular volume of an irradiated primate hemimandible was less than 50% of the unirradiated side. This activated-perfusant method of determining vascular volume in a series of animals after varying exposures and postirradiation perfusion schedules should produce quantitative data valuable in planning reconstructive procedures. Information as to the rate of decline of postirradiation vascular volume, its consistency, and its total quantity would provide the surgeon a more physiologic assessment of a proposed postirradiation surgical site. (GRA)

1143 (AED-CONF-74-494-002) RELATIVE BIOLOGICAL EFFICIENCY OF ELECTRONS AND PHOTONS OF A 42 MeV BETATRON. LD 50/30 for Mice. Heuss, K. (Allgemeine Ortskrankenkasse Koeln (F. R. Germany). Strahleninstitut). 1974. 8p. (In Germany). INIS.

From 5th scientific symposium of the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Essen, F. R. Germany (8 Oct 1974).

3 figs.; 4 tabs.; 13 refs. With abstract. Will be published in Strahlentherapie.

The LD 50/30d in young NMRI mice was determined. Comparisons were made for 200 kvp x rays, ^{60}Co γ rays, 35-MeV electrons and 42-MV bremsstrahlung. The dose rate was in all experiments between 60 and 80 rads per minute. The beam geometry and the spatial dose distributions were held as equal as possible. With 200 kvp x rays as unity the same RBE factor (0.80 ± 0.05) resulted for ^{60}Co γ rays, 35-MeV electrons, and 42 MV bremsstrahlung. (auth)

1144 (AED-CONF-74-509-034) ON THE CLASS 'A' FISSION-NEUTRON-IRRADIATION OF SMALL LABORATORY ANIMALS. Zarand, P. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugarageszsegugyi Kutato Intezet, Budapest (Hungary)). 1974. 12p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F.R. Germany (30 Sep 1974).

4 figs.; 2 tabs.; 21 refs. With abstract. Available from ZAED.

Average absorbed dose values were calculated in various small laboratory animals (mouse, rat, guinea-pig) with an albedo code and the homogeneity of the irradiation was studied. A plane source emitting neutrons with a cosine distribution was used. The neutron spectrum is that measured in the irradiation facility of the Hungarian Research Reactor. Infinite length cylinders with radii of 1.25, 2.5, and 3.3 cm were used. The average absorbed dose was 85.2, 72.1, and 64.9% of the free-in-air kerma. None of the irradiations was uniform when unilateral irradiation was assumed. A uniform, Class A irradiation $D_{max}/D_{min} = 1.15$ could not be achieved in rat and guinea-pig if only bilateral irradiation or rotation was used. With various field-shaping filters a very homogeneous irradiation may be performed with $D_{max}/D_{min} = 1.05$ in all three types of animals. Present calculations were compared with other values (measured or calculated) published in the literature. (auth)

1145 (TID-3919) IONIZING RADIATION AND WILD BIRDS, A Selected Bibliography. Schultz, V. (Washington State Univ., Pullman (USA). Dept. of Zoology). 1974. 24p. Dep. NTIS $4.00.

The bibliography contains 225 citations to literature concerned with ionizing radiation and wild birds. Contained within these 225 citations are some references on bird populations on USAEC operational areas even though comments on ionizing radiation are lacking. (ERB)

1146 (UCB-34P82-17) ELECTROPHYSIOLOGICAL AND BIOCHEMICAL STUDIES OF THE EFFECTS OF RADIATION ON BRAIN ACTIVITY AND DEVELOPMENT. Progress Report, November 1973–October 31, 1974. Timiras, P. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. Contract AT(04-3)-34. 26p. Dep. NTIS $4.50.

Some biochemical aspects of synaptogenesis were explored in recent studies, through the use of x-radiation techniques, particularly in the cerebellum where x radiation was shown to preferentially destroy specific cell populations (the external granular layer cells) as well as to inhibit cell migration. Studies in this area demonstrated clearly that x radiation causes significant abnormalities in cholinergic neurotransmission, in GABA, and in monoamine metabolism. These abnormalities were localized to CNS regions, such as the cerebellum, which were active in terms of cell proliferation, cell migration, and growth at the time of exposure to x-irradiation. The data accumulated thus far does not yet allow conclusions to be drawn as to the mode of action whereby x radiation brings about the increase in cholinergic and monaminergic metabolism; however, it is proposed that x radiation interferes with developmental aspects of neurotransmitter metabolism involving, perhaps, alterations to the cell population of the receptor area and/or changes in the branching of axonal terminals of the particular transmitter neuron. It was further hypothesized that when abnormalities occur in the physical contact of neurons, at critical developmental stages of the nervous system, biochemical aspects of cell differentiation related to neurotransmission are concomitantly affected. Different fibers exert a trophic influence on developing neurons and, consequently, that cell connectivity is integrally related to neuronal maturation. Indeed, it has been postulated that the neurotransmitter itself may represent the identification system for proper cell connectivity, and alternately, that proper cell connectivity may be the necessary prerequisite for determining the type of chemical transmitter substance that will characterize the established synapse. Ongoing experiments demonstrate an increase in the acetylcholine enzyme system as well as in the GABA levels in the Reeler mutant mouse. These changes are the same as those induced by neonatal x radiation and support the view that abnormal cell proliferation and migration leads to abnormalities in biochemical aspects of neurotransmission in the developing synapse. (auth)

1147 (UR-3490-711) LATE RADIATION ENCEPHALOPATHY IN THE DOG. A Model for Cerebral Vascular Disease. Michaelson, S. M.; Kramer, M. W. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). [nd]. 31p. Dep. NTIS $4.75.

The Research Group on Industrial and Environmental Neurology has suggested that assessment of cerebral atherosclerosis should be considered as part of its purview of problems of interest. Although the present study is not related to the ordinary environmental or industrial situation, it can apply to accidental overexposure to external ionizing radiation or radiation therapy and describes an animal model that can be used for fundamental study of cerebral vascular conditions and encephalomalacia. Ionizing radiation damage to nervous tissue may be apparent early after irradiation or may become evident after a variable latent period. The concept of late ionizing radiation-induced neuropathy, the subject of this study, is characterized by a long latent period between exposure and initial clinical signs, an inverse relationship between radiation dose and latency of appearance of late radiation encephalopathy, and an apparent lack of demonstrable physiological, biochemical, and morphological alterations until necrosis becomes manifest. (auth)

1148 ADAPTATION TO HYPOXIA AS A FACTOR THAT MODIFIES ITS RADIOPROTECTIVE EFFECT. Ovakimov, V. G.; Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; No. 6, 49-53(1974). (In Russian).

Studies conducted on 1400 random bred mice, 22 to 24 gm, demonstrated that acute hypoxic hypoxia (6% O_2 in the inhaled gaseous mixture) had a protective effect vis-a-vis cesium gamma radiation, which can be significantly alleviated by slow adaptation to 8 to 10% O_2. The studies also showed that short-term exposure (2 to 5 min) to 6% O_2 resulted in an 80% or greater survival of the animals by the 30th day between exposure levels of 1200 to 1600 R. Exposing the mice to protracted states of hypoxia resulted in zero survival rate of animals exposed to 1400 R (710 R/min). (JPRS)

1149 EFFECTS OF EXPOSURE TO IONIZING RADIATION ON BRAIN ULTRASTRUCTURE AND METABOLISM IN MAMMALS. Pausescu, E.; Paun, C.; Teodosiu, T. Rev. Sanit. Mil.; No. 4, 325-334(1974). (In Rumanian).

The effects of ionizing radiation on monkeys, guinea pigs, and dogs are reported. Microscopic studies revealed a process of hyperhydration of the cellular structures depending on the radiation dose and evolving from a simple edematous aspect of the glial structures, mitochondrial swelling and enlargement of the endoplasmic reticulum to cell pinocytotic vacuolization and disintegration, equally affecting the glial, epithelial, and neuronal elements. Metabolic determinations showed the following significant alterations: accumulation and abnormal distribution of glycogen and acid mucopolysaccharides within the various brain structures and cell ultrastructural elements; reduction of the brain reserves of macroergic phosphates, especially ATP, in the brain subcellular fractions, and mainly in the mitochondrial and cytoplasmic fractions; decrease in the activity of some enzymes involved in carbohydrate oxidation and phosphorylation (ATP-ase and phosphatases); depletion of the brain reserves (especially mitochondrial and nuclear reserves, of nicotinamide adenine nucleotides in both forms, particularly the reduced forms); and an apparently nonenzymatic decrease in the main subcellular fractions (the activity of cerebral NADH-dependent glutathione reductase was not affected). (JPRS)

1150 ONTOGENETIC CHANGES IN THE ULTRASTRUCTURE OF RAT HEPATOCYTE ORGANELLES AFTER PRENATAL X IRRADIATION. Chedid, A.; Nair, V. (Univ. of Cincinnati). Radiat. Res.; 62: No. 1, 123-132(Apr 1975).

The effects of prenatal x irradiation on the development of hepatocyte organelles have been studied in Sprague-Dawley rats. Pregnant rats received 50 R to the pelvic region on the 13th gestation day (g.d.). Animals were sacrificed on g.d.'s 15 and 20, day of birth, and 5th postnatal day. The fetal and neonatal livers were obtained and processed for electron-microscopic examination. The most striking discernible change after irradiation involves the appearance of cytoplasmic "polyribosomal aggregates" in the hepatocyte specimens of 15th and 20th g.d.'s. In the control rat, smooth endoplasmic reticulum (SER) appears for the first time on 20th g.d., while no SER could be detected in the hepatocytes from the irradiated animals at this period nor on day of birth. In the irradiated animals, SER was observed on the 5th postnatal day. Our results are consistent with the hypothesis that lipid peroxidation membrane alteration, delayed appearance of SER, and "polyribosomal aggregation" may be sequentially linked events after prenatal x irradiation. (auth)

1151 EFFECTS OF X IRRADIATION ON ESTROGEN-INDUCED SYNTHETIC PROCESSES OF THE AVIAN LIVER. Holshouser, S. J.; Schjeide, O. A.; Briles, W. E. (Northern Illinois Univ., Dekalb). Radiat. Res.; 62: No. 1, 52-61(Apr 1975).

Effects of x irradiation on protein and lipid synthesis were studied, using estrogen-induced yolk protein syntheses by the avian liver as a test model. Female chickens, receiving a single sublethal whole-body exposure of 600 R of x irradiation at 5 wk of age, laid fewer and smaller eggs upon reaching maturity as compared to nonirradiated controls. However, chemical contents and ultracentrifuge patterns of yolk proteins were not found to be qualitatively different. Accordingly, the synthesis of no one major yolk protein appeared to be selectively inhibited by exposure of the bird to irradiation. Injection of Estrogenic Substances into hens over a period of 3 days resulted in a much greater enlargement of livers in control estrogenized birds than in irradiated estrogenized birds. Differences were also ascertained to exist between control and irradiated birds in terms of total liver RNA. This would seem to indicate a greater potential for synthesis of serum yolk protein precursors in nonirradiated estrogenized hens. (auth)

1152 RECOVERY RATE AND RESIDUAL INJURY IN MONKEYS EXPOSED TO LARGE DOSES OF RADIATION BY FRACTIONATION. Spalding, J. F.; Holland, L. M.; Johnson, O. S.; Prine, J. R. (Los Alamos Scientific Lab., NM). Radiat. Res; 62: No. 1, 70-78(Apr 1975).

The target site and nature of the long-term residual lesion (LTRL) caused by exposure to ionizing radiations are not well understood. Monkeys (Macaca mulatta) were given 100-rad conditioning doses of gamma rays at 56-day intervals to accumulate 2400 rad. Eighty-four days after the 24th conditioning exposure, the monkeys were challenged to death with continuous low-dose-rate gamma rays. The response of hematopoietic tissue was observed as the primary site of acute and long-term radiation injury. Hemograms were performed on monkeys during the fractionation radiation regimen used to administer conditioning doses and during the subsequent continuously delivered challenge exposures. Recovery rate from radiation injury was found to be independent of total accumulated gamma-ray dose. The LTRL from gamma ray conditioning doses totaling 2400 rad did not significantly decrease mean survival time (MST) in a radiation field of 24 rad/23.5-hr day. (auth)

1153 EXPOSURE OF RABBIT ERYTHROCYTES TO MICROWAVE RADIATION. Hamrick, P. E.; Zinkl, J. G. (National Inst. of Environmental Health Sciences, Research Triangle Park, NC). Radiat. Res.; 62: No. 1, 164-168(Apr 1975).

Rabbit erythrocytes were exposed to microwave radiation at 2450 and 3000 MHz in an attempt to duplicate reported changes in the erythrocyte membrane permeability to potassium and changes in osmotic resistance. However, our results show no significant difference between exposed and control erythrocyte suspensions in either potassium efflux or in osmotic resistance. (auth)

1154 ANDROGENETIC HAPLOID DEVELOPMENT PRODUCED BY RUBY LASER IRRADIATION OF ANURAN OVA. Ellinger, M. S.; King, D. R.; McKinnell, R. G. (Univ. of Minnesota, Minneapolis). Radiat. Res.; 62: No. 1, 117-122(Apr 1975).

Material meiotic chromosomes and spindles of freshly inseminated Rana pipiens ova were inactivated by a pulsed microbeam ruby laser. Embryos that ensued from this procedure were haploid and were compared to manually enucleated androgenetic embryos in a study designed to detect developmentally significant damage associated with enucleation by laser irradiation. Morphologic anomalies did not appear to differ between the two groups of haploids. While no significant difference in average life span between androgenetic haploids produced by laser irradiation or manual enucleation was observed, the precise dosimetry of the laser technique appears to reduce significantly the variability of longevity. (auth)

1155 ACUTE CARDIOVASCULAR AND AUTONOMIC EFFECTS OF WR-2721: A RADIOPROTECTIVE COMPOUND. Caldwell, R. W.; Heiffer, M. H. (Univ. of Tennessee, Memphis). Radiat. Res.; 62: No. 1, 62-69(Apr 1975).

WR-2721 is a chemical which has shown much promise as a protective agent in animals exposed to ionizing radiation. Our experiments on anesthetized dogs and cats indicate that WR-2721 has little acute cardiovascular action in these animals when given intravenously in doses of 50 to 200 mg/kg. A total cumulative dose of 600 mg/kg within 2 hr was not lethal and, indeed, was well tolerated. Arterial blood pressure was not markedly lowered in dogs and cats given these doses. In dogs, a slight vasodilation was noted in the femoral vascular bed after intra-arterial injection. Mydriasis and watery salivation were observed in all animals. In the dog, WR-2721 (100 mg/kg) was observed to produce blockade of the bilateral carotid artery-occlusion pressor response, the pressor response to the ganglionic stimulant DMPP, and the bradycardia to vagus nerve stimulation. In the cat, WR-2721 (100 mg/kg) also blocked the contraction of the cat nictitating membrane due to stimulation of the preganglionic fibers of the superior cervical ganglion, but not the contraction seen with postganglionic fiber stimulation. Our experiments indicate that WR-2721 is a ganglionic blocking agent. It does not share this property with closely related structural congeners. (auth)

1156 STUDIES CONCERNING THE EFFECT OF X-RAYS ON ELECTROLYTIC SHIFTS AND ON THE METABOLISM OF THE MYOCARDIUM P. 4. Radiation-Induced Changes in the Concentration of Some High-Energy Phosphate Compounds. Prignitz, R.; Koehler, M.; Hoffmeister, G. (Marburg Univ. (F. R. Germany). Klinik und Poliklinik fuer Strahlentherapie und Roentgendiagnostik). Strahlentherapie; 148: No. 6, 645-652(Dec 1974). (In German).

A study was made concerning the behavior of some high-energy phosphate compounds in the myocardium of guinea pigs following local irradiation with 1,000 to 6,000 R. The ATP and KrP concentrations show a significant drop at a dose level of not more than 1,000 R. The content of inorganic phosphate shows a distinct rise in dependence of both dose and time. Further studies carried out after separating ATP by thin-layer chromatography confirmed the drop in the ATP content under irradiation; a significant rise in ^{32}P absorption by the ATP fraction of the myocardium occurs at the same time and is conclusive of increased ATP synthesis. (auth)

1157 EFFECT OF ANDROGENIC HORMONES ON BONE MARROW OF RATS RECEIVING CHEMOTHERAPY. Horn, Y. (Hadassah Univ. Hospital, Jerusalem). Oncology; 25: No. 6, 512-519(1971).

Three androgenic hormones, testosterone, mesterolone (proviron) and halotestin were compared as leucopoietic stimulants in rats treated with 0.2 mg of nitrogen mustard. The leucocyte reserve was determined at the end of each experiment by injecting salmonella vaccine. Data were analyzed to compare differences between prophylactic and therapeutic treatments, and between sexes. Results obtained with equal doses of testosterone in both irradiated and chemotherapeutic treated rats were also compared. It was concluded that the hormones stimulated the bone marrow during injection without elevating the amount of white blood cells in the reservoirs, which were depressed after chemotherapy. Consequently, the addition of the endotoxin had no effect on the bone marrows. (auth)

1158 BIOLOGICAL ALTERATIONS RESULTING FROM CHRONIC LUNG IRRADIATION. III. Effect of Partial ^{60}Co Thoracic Irradiation Upon Pulmonary Collagen Metabolism and Fractionation in Syrian Hamsters. Pickrell, J. A.; Harris, D. V.; Hahn, F. F.; Belasich, J. J.; Jones, R. K. (Lovelace Foundation, Albuquerque, NM). Radiat. Res.; 62: No. 1, 133-144(Apr 1975).

Radiation-induced changes in pulmonary collagen metabolism were studied in Syrian hamsters given multiple thoracic doses of ^{60}Co radiation to achieve cumulative exposures of 6000, 4000, and 2000 R. At 13 to 14 wk after initial exposure, 6000- and 4000-R exposures had increased incorporation of injected [^{14}C]proline into pulmonary collagenous protein which suggested an increased collagen synthesis. By 21 to 22 wk after exposure, increased pulmonary soluble collagen was noted. Increased pulmonary scarring was indicated by a variable increase in native collagen at 13 to 36 wk. A collection of alveolar macrophages at 7 to 8 wk followed by inflammation at 13 to 14 wk and a beginning of pulmonary fibrosis at 13 to 19 wk were noted. At 21 to 22 wk after exposure a somewhat more marked pulmonary fibrosis and some epithelialization were observed. Hemosiderin deposits were also observed at 35 to 36 wk after exposure, but pathologic processes were lessened by this time. The early activation of collagen synthesis presumably caused the radiation-induced fibrosis. Later, when collagen tended to accumulate, the synthetic rate was normal. The activation of collagen synthesis caused by external thoracic irradiation resembles that caused by thoracic irradiation from the internal emitter, ^{144}Ce. Moreover, it demonstrates the usefulness of monitoring collagen biosynthesis by [^{14}C]proline incorporation into the lung. (auth)

1159 METHYLATION OF RAT LIVER tRNA UNDER DIFFERENT EXPERIMENTAL STATES OF THE ORGANISM. Kucherenko, M. E.; Gavrilei, V. I. (Kiev State Univ.). Ukr. Biokhim. Zh.; 47: No. 2, 205-208(1975). (In Ukrainian).

The primary biochemical and conformational changes in tRNA of the albino rat liver were studied under conditions of x-ray irradiation and under the effect of prozerine and nicotinic acid. Under the effect of these factors the rate of the liver tRNA methylation increases by 45, 103, and 112%, respectively. The melting point of the tRNA control preparations is 61°C, under the effect of irradiation—57°C, under the prozerine and nicotinic acid effect—52°C. Hyperchromia of the tRNA control and experimental preparations is equal to 28, 30, and 34%, respectively. No changes were found in sedimentation coefficient of the tRNA control and experimental preparations. (auth)

1160 EFFECT OF X IRRADIATION ON THE ALANINE- AND ASPARTATE AMINOTRANSFERASE ACTIVITY IN THE LIVER, KIDNEY, AND SPLEEN OF MOUSE. Juhgowska-Klin, B.; Lozinska, M.; Wojtaszek, J. (Univ., Wroclaw). Acta Physiol. Pol.; 24: No. 1, 95-101(1975).

The alanine- and aspartate aminotransferase (GOT and GPT) activities and the protein content were measured in the liver, kidney, and spleen homogenates of mice exposed to a single whole-body x irradiation with a 900 R dose. The assays were performed in 6 h intervals during the first day and 24 h intervals from the 2nd until the 6th day after the exposure. Significant differences in the enzymatic activity were found in the course of 24 h in control animals and a marked increase of this activity was found after irradiation. This may be explained by changes in the permeability of the mitochondrial membrane for enzyme molecules. (auth)

1161 INFLUENCE OF THYMIC CELLS ON THE NUMBER OF HEMOPOIETIC STEM CELLS IN THE SPLEEN OF SUBLETHALLY IRRADIATED MICE. Kozlov, V. A.; Kolesnikova, S. M.; Robinson, M. V.; Trufakin, V. A. (Inst. of Clinical and Experimental Medicine, Novosibirsk, USSR). Ukr. Biokhim. Zh.; 17: No. 3, 327-331(Mar 1975). (In Russian).

With the aid of Till and McCulloch's method, 5×10^6 thymic cells were found to cause an increase in the number of hemopoietic endogenous spleen colonies in syngeneic donor-recipient combination. Thymic cells of C57BL mice had no effect on the number of endogenous colonies in the spleen. 40×10^6 thymic cells administered 24 hr after sublethal irradiation caused an increase in the number of colony forming units in the spleen within 14 days. Possible ways of the thymus effect on hemopoiesis are discussed. (auth)

1162 ANTIBODY-MEDIATED SUPPRESSION OF GRAFTED LYMPHOMA. III. Evaluation of the Role of Thymic Function, non-Thymus-Derived Lymphocytes, Macrophages, Platelets, and Polymorphonuclear Leukocytes in Syngeneic and Allogeneic Hosts. Shin, H. S.; Hayden, M.; Langley, S.; Kaliss, N.; Smith, M. R. (Johns Hopkins Univ., Baltimore). J. Immunol.; 114: No. 4, 1255-1263(Apr 1975).

Syngeneic or allogeneic mice pretreated with sublethal whole-body irradiation were rendered incapable of suppressing the growth of grafted tumor cells sensitized with alloantibody. The growth of sensitized tumor cells was suppressed when they were mixed with donor effector cells from mice syngeneic or allogeneic to the recipients and then were inoculated in irradiated recipients. Three donor-host combinations were used to study the suppression of the murine lymphoma 6C3HED indigenous to C3H mice. These were C3H donor cells in C3H recipients, C57BL/6 donor cells in C3H recipients, or C57BL/6 donor cells in C57BL/6 recipients. In all three combinations, macrophages obtained from an inflammatory exudate, exudate lymphocytes not bearing theta antigen, and platelets were, in descending order of effectiveness, consistently active in restoring antibody-mediated suppression of tumor growth in irradiated hosts. Prior irradiation of the transferred lymphocytes somewhat diminished their effectiveness. Freeze-thawed or heat-killed macrophages (but not freeze-thawed platelets or lymphocytes) were effective in restoration. Peripheral blood mononuclear leukocytes and splenic lymphoid cells were not active in the recipients syngeneic to the donor cells but were active in recipients allogeneic to the donor cells. Polymorphonuclear leukocytes isolated from peripheral blood or an inflammatory exudate were not active. Intact thymic function seems unimportant since antibody-mediated suppression took place as effectively in thymectomized mice as in normal controls. (auth)

1163 NORMAL FUNCTION OF IMMUNOLOGIC STEM CELLS FROM AGED MICE. Harrison, D. E.; Doubleday, J. W. (Jackson Lab., Bar Harbor, ME). J. Immunol.; 114: No. 4, 1314-1317 (Apr 1975).

Marrow or spleen grafts from aged donor mice produced antibody-forming cells as effectively as did grafts from younger controls in recipients tested 3 to 10 months after the transplantation. All recipients were lethally irradiated, and the T6 chromosome marker was used to demonstrate that they were populated by donor cell lines. Recipients of aged or younger control grafts gave similar responses when stimulated with varying doses of antigen and when tested at different times after the transplantation except in two cases. Recipients of aged spleen grafts gave significantly lower responses than younger controls for the first few weeks after the transplantation. If recipients had been thymectomized before lethal irradiation, aged cell lines (pooled marrow and spleen cells) gave only 37 percent of the responses of younger controls. Given sufficient time and intact young recipients, immunologic stem cell lines from old donors populated recipients with cells having normal immune responses. These results suggest that age-related immunologic defects are not intrinsically timed in the precursor cell lines that populate the immune system. (auth)

1164 CELLULAR COOPERATION DURING IN VIVO ANTI-HAPTEN ANTIBODY RESPONSES. I. The Effect of Cell Num-

ber on the Response. Janeway, C. A., Jr. (National Inst. of Allergy and Infectious Diseases, Bethesda, MD). J. Immunol.; 114: No. 4, 1394-1401(Apr 1975).

Cellular interactions in adoptive secondary anti-hapten antibody responses to the hapten 2,4-dinitrophenyl (DNP) have been studied. It was shown that DNP-specific B cells must interact with carrier specific helper T cells to give optimal responses. Independent titration of B cell and helper cell activity in adoptive anti-DNP antibody responses gave the following results: Doubling the number of transferred B cells approximately doubled the subsequent antibody response. Doubling the number of helper cells leads to nearly 4 times as much anti-DNP antibody, measured 7 days after boosting ("premium effect"). This marked effect of helper cell number on the antibody response is thought to be due primarily to the interaction of two populations of carrier-specific cells in the helper effect, or to the interaction of two activities of a single population of helper cells, namely clone activation and clone expansion. Only a very small proportion of the premium effect given by helper cells could be attributed to increases in antibody affinity. (auth)

1165 CELLULAR COOPERATION DURING IN VIVO ANTI-HAPTEN ANTIBODY RESPONSES. II. The Effect of In Vivo and In Vitro X Irradiation on T and B Cells. Janeway, C. A., Jr. (National Inst. of Allergy and Infectious Diseases, Bethesda, MD). J. Immunol.; 114: No. 4, 1402-1407(Apr 1975).

The effect of x-irradiation on T and B cells involved in an in vivo adoptive anti-hapten antibody response has been studied. In vitro x-irradiation inactivates both B cells and T cells. B cells are somewhat more sensitive than T cells to such treatment, the dose required to reduce B cell activity by 50 percent being about 50 R, whereas 200 R will reduce helper cell activity by 50 percent. By contrast, if recipient mice are primed with carrier, they develop helper activity that is totally resistant to 500 R x-irradiation within 3 days of immunization. This activity can not be transferred from irradiated, carrier-primed mice by either spleen cells or serum, although anti-carrier antibody is shown to give a modest helper effect late after boosting. However, this radioresistant helper effect can be reproduced in a cell transfer system by giving carrier-primed spleen cells to normal recipients that are then x-irradiated (500 R) and given a large dose of carrier protein. Neither cells nor carrier alone will give rise to such radioresistant helper effects. Similar helper activity is occasionally observed when normal mice are irradiated 24 hr after being given helper cells, in the absence of carrier, and boosted shortly thereafter. The differences between these radioresistant helper effects, and the radiosensitivity of helper cells transferred after x-irradiation, may be related to x-ray induced changes in cell migration patterns. (auth)

1166 SERUM COLONY STIMULATING AND INHIBITING FACTORS IN IRRADIATED GERMFREE AND CONVENTIONAL MICE. Quesenberry, P. J.; Bealmear, P.; Ryan, M.; Stohlman, F. Jr. (Saint Elizabeth's Hospital, Boston). Brit. J. Haematol.; 28: No. 4, 531-539(Dec 1974).

Colony-stimulating factor (CSF) elevations were seen at varying times after lethal irradiation of conventional CF_1 and CFW mice but no elevations were noted in germfree CFW mice. Changes in serum inhibitor activity after irradiation were variable and did not explain the CSF increases. Both conventional and germfree mice responded to endotoxin with similar increases in serum CSF before and after irradiation. Serum CSF levels in mice with irradiation-induced myeloid aplasia may be normal and yet these myeloid depleted mice retain the capacity to generate increased serum CSF levels after endotoxin injection. These data suggested that in the irradiated mouse serum CSF levels were not determined by the peripheral blood or marrow neutrophil numbers, but were more likely related to a functional demand on the neutrophil such as bacterial killing. (auth)

1167 RADIOSENSITIZATION OF C3H MOUSE MAMMARY TUMOURS BY A 2-NITROIMIDAZOLE DRUG. Sheldon, P. W.; Foster, J. L.; Fowler, J. F. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Cancer; 30: No. 6, 560-565(Dec 1974).

Local tumor control was determined at 150 days after single doses of 240 kV x rays given with or without 1 mg/g body weight of the hypoxic cell radiosensitizer Ro-07-0582. The dose required to control 50% of the tumors (TCD50) was reduced from 4380 to 2410 rad, yielding an enhancement ratio of 1.82 ± 0.07 s.e. mean. This compared favorably with the corresponding single dose gain factor for fast neutrons, which was about 1.7. (auth)

1168 FORMATION OF PIGMENTS OF A LIPID NATURE IN ANIMAL TISSUES DURING MALIGNANT GROWTH AND IRRADIATION. Vertushkov, V. T.; Ivanov, I. I.; Tarusov, B. N. (Moscow State Univ.). Biophysics (USSR) (Engl. Transl.); 19: No. 2, 295-299(Jan 1975).

Colored polymer products found in the lipids of the spleen, blood, and bone marrow of mice and rats during malignant growth and after x irradiation were studied. A number of radioprotectors including endogenous ones, adrenaline, serotonin, and histamine, sharply accelerated the process of polymerization of the lipids. It was assumed that the polymer products of oxidation of the lipids in vivo may be regarded as carcinogenic compounds of endogenous origin. (auth)

1169 PATHOGENESIS OF LIVER FUNCTION DISTURBANCES FOLLOWING LOCAL IRRADIATION. Svesnikov, A. A.; Gileva, T. P.; Bandurko, L. N. Radiobiol.-Radiother.; 15: No. 6, 731-740 (1974). (In German).

With the aim to clarify the pathogenesis of liver function disturbances with local irradiation of the hepatic region, the exposed liver or the exposed stomach were irradiated separately or a section of the animal (hepatic region) not including liver and stomach. Functional changes were found in the irradiated liver with doses from 3000 rad forth, whereas essentially lower doses, 1000 to 1600 rad, were necessary for the rise of changes in the intact (non-irradiated) liver with irradiation to the stomach and intestine. Functional disturbances were clearly accompanied with marked morphological changes: the damage did not only manifest itself in the development of an interstitial hepatitis but also in a necrosis of certain sections of the hepatic tissue. These results point to the fact that the effects mediated by the gastrointestinal tract mainly influence function and structure of the liver the indirect changes in the liver with irradiation of other organs (stomach, intestine) rising with essential lower doses than with direct action of ionizing radiation on the liver. With simultaneous irradiation of liver and stomach (hepatic region) changes with doses of 400 to 800 rad were found. This led to the assumption that latent damages occur in the liver with irradiation with doses of less than 3000 rad and these are manifest in the presence of indirect influences by other organs. These results allow to interpret the contradictory opinions about liver sensitivity to the effect of ionizing radiation: when the liver only was irradiated the investigators came to the opinion of the organ's radioresistance. In case of the irradiation of the hepatic region, when stomach and intestine were also irradiated besides the liver, latent damages occurred due to the indirect influence by these organs thus leading the investigators to the view of radiosensitivity of the liver. (auth)

1170 GLYCOGEN IN NON-GERMINAL CELLS OF RAT TESTIS FOLLOWING GAMMA IRRADIATION. Gupta, G. S.; Bawa, S. R. (Punjab Univ., Chandigarh, India). J. Reprod. Fert.; 41: No. 1, 185-188(Nov 1974).

Changes in glycogen levels were measured in atrophic testes of rats following γ irradiation. The radiation dose varied from 720 to 6000 R. The data show that there is an initial increase in the glycogen/g testis by about day 5 after irradiation. This is followed by a fall to about the normal range on day 20, followed by a further increase by day 30. Subsequently, the level of glycogen is reasonably maintained. When expressed in terms of glycogen/testis there is again an increase by day 5, followed by a fall and, thereafter, the glycogen level remains at or near the normal level. It is shown that glycogen accumulation/g testis 15 days after irradiation is a dose-response phenomenon and increases with increasing doses up to 6000 R. In terms of glycogen/testis, however, the level at different doses does not deviate from the normal range. Possible factors responsible for the higher content of glycogen in irradiated testes is discussed. (UK)

1171 INCREASED SYNTHESIS OF LOW-MOLECULAR-WEIGHT NUCLEAR RIBONUCLEIC ACIDS OF RAT LIVER AFTER GAMMA IRRADIATION AND HEPATECTOMY. Fonagy, A.; Hidvegi, E. J. (Orszagos Federic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). Biochem. J.; 146: No. 2, 357-360(Feb 1975).

Incorporation of [^{3}H]orotic acid into low-molecular-weight nRNA of rat liver, fractionated on polyacrylamide gels, increased 6 to 12 h after partial hepatectomy and 6 h after γ irradiation at 2000 R. The incorporation of orotic acid was particularly increased into the 4.5 S, 5S, and approx. 10S nRNA fractions. If the irradiation was given after 6 h of regeneration and RNA was isolated from the nucleus 12 h after hepatectomy then the incorporation of orotic acid into these low-molecular-weight nRNA components was greater than after hepatectomy or irradiation alone. (auth)

1172 DOSE-SURVIVAL TIME RELATIONSHIP OF PARTIALLY IRRADIATED RABBITS. Ueno, Y.; Takashima, K.; Nakase, A. (Kyoto Univ.). Radiobiol.-Radiother.; 15: No. 6, 705-707(1974).

The single irradiation of 1,250 to 2,750 R to the upper abdominal region of rabbits induced the hemopoietic type of death and

did not cause the gastrointestinal type of death. A dose of more than 3,000 R seems to be required for gastrointestinal death in irradiation to the upper abdominal region of rabbits. (auth)

1173 MITOTIC ACTIVITY AND FREQUENCY OF CHROMOSOMAL ABERRATIONS IN THE REGENERATING LIVER OF CONTINUOUSLY IRRADIATED RATS. Misurova, E.; Kropacova, K.; Praslicka, M. (Univ., Kosice, Czech.). Radiobiol.-Radiother.; 15: No. 6, 709-714(1974). (In German).

Mitotic index (MI), ratio of metaphase to prophase (M/P), and percentage of chromosomal aberrations in postmetaphase of the regenerating liver of rats were followed after continuous irradiation with the daily dose rates 0.1 to 60 R during 20 to 80 days. According to our results, during continuous irradiation damage is accumulated in the intact liver of rats manifesting itself after partial hepatectomy by the inhibition of MI, by the change of M/P ratio, and by the increased frequency of chromosomal aberrations. On the basis of the MI and M/P ratio change extent, the mechanisms influencing the onset of mitosis are supposed to be more affected by continuous irradiation than those influencing the mutual ratio of the duration of prophase and metaphase. (auth)

1174 ENDOCRINE METABOLIC MECHANISM IN THE REGENERATION OF HEMATOPOIESIS AFTER IRRADIATION. Barkalaja, I. A. (Inst. of Biophysics, Moscow). Radiobiol.-Radiother.; 15: No. 6, 715-723(1974). (In German).

The present paper tries to find a pathogenetic connection between the effect of glucocorticoids on carbohydrate metabolism and on the regeneration of hematopoiesis in acute radiation sickness. It was assumed that hypercorticism at the peak of radiation sickness is able to restrict the carbohydrate supply of bone marrow by directing carbohydrate metabolism according to the glucocorticoid type and to suppress the energetic stimulation of vital activity and of cell division in it. Experiments were carried out on white rats that were whole-body irradiated with a dose of 750 R. Corticosterone content and glucose concentration in the blood were determined. Total cell count was counted in bone marrow. Besides that the mitotic index was determined and hemomyelogram was examined. The obtained values were analyzed by parallel opposition. First of all it was clarified that hyperglycemia during hypercorticism at the peak of radiation sickness is a result of the preponderance of the influence of glucocorticoids in carbohydrate metabolism over insulin. Furthermore, it was found that the regeneration of bone-marrow blood formation is reversely dependent on hyperglycemia after irradiation. In order to improve glucose supply of bone-marrow cells and to activate their transformation to the energetic stimulus of vital activity of these cells, insulin was applied for the utilization of glucocorticoid hyperglycemia. As the result of the hypoglycemizing effect of insulin an intensification of the mitotic activity up to optimum limits and a stimulation of the regeneration of bone-marrow blood formation was observed. It is assumed that the mechanism of the stimulating effect of insulin on hematopoiesis is based upon its ability to participate in the carbohydrate energetic as well as plastic processes. (auth)

1175 INTESTINAL FORM OF RADIATION SICKNESS AFTER NONUNIFORM IRRADIATION OF RATS. Moroz, B. B.; Fedorovskii, L. L. Radiobiol.-Radiother.; 15: No. 6, 725-730(1974). (In German).

Some mechanisms of the intestinal form of radiation sickness were investigated with non-uniformly irradiated rats. The examinations were carried out on 200 inbreeding-free male rats weighing 180 to 200 g. Rats were exposed to a non-uniform irradiation (1050 R to the intestine and 735 R to the remaining body), a uniform total irradiation (1050 R), or local intestinal irradiation (2200 R) in doses after the application of which the animals died within 3.5 to 5 days. With the not uniform irradiated animals an autotransplantation of bone marrow (about 40×10^6 cells) was carried out. DNA-content in the duodenal mucosa, ^{14}C-thymidine incorporation into DNA, ^{14}C-glycine incorporation into mucosal protein, into alkaline phosphatase activity; and intestinal vessel permeability for ^{51}Cr-albumin were estimated. A favorable effect of bone marrow transplantation on the recovery processes in the rat intestine was shown. After not uniform irradiation with a dose causing the death of the animals within 3.5 to 5 days intestinal vessel permeability considerably increased compared to whole-body irradiation with the minimum dose having the same effect. Autotransplantation of bone marrow decreased the number of animals dying in the first 5 days and strengthened the reparative processes in the irradiated intestine. The disturbed intestinal permeability plays a leading role in the mechanism of intestinal radiation sickness. (auth)

1176 IRRADIATION AND HYDROPROTEOLYTIC CELL ACTIVITY. Kocmierska-Grodzka, D. (Pharmakologischen Institut der Medizinischen, Bialystok, Poland). Radiobiol.-Radiother.; 15: No. 6, 771-779(1974). (In German).

The communication is a review of the literature about the intracellular (lysosomal) activity of hydroproteolytic enzymes after irradiation. The results of own examinations carried out on differently radiosensitive rat tissues after whole-body irradiation of the animals with sublethal, lethal, and supralethal x-ray doses were discussed. (auth)

1177 REPOPULATION WITH IgA-CONTAINING CELLS OF BRONCHIAL AND INTESTINAL LAMINA PROPRIA AFTER TRANSFER OF HOMOLOGOUS PEYER'S PATCH AND BRONCHIAL LYMPHOCYTES. Rudzik, R.; Clancy, R. L.; Perey, D. Y. E.; Day, R. P.; Bienenstock, J. (McMaster Univ., Hamilton, Ont.). J. Immunol.; 114: No. 5, 1599-1604(May 1975).

Transfer of 50 million rabbit allogeneic lymphocytes from either bronchus-associated lymphoid tissue (BALT) or Peyer's patches into 1000 R x-irradiated recipients results, 6 days later, in predominant repopulation of gut and bronchial lamina propria, as well as spleen, with IgA-containing cells. After repopulation with BALT or Peyer's patch cells, lymphoid follicles in both gut and lung showed peripheral cellular membrane type of fluorescence with fluorescein-conjugated anti-IgA antisera only. Six days after x-irradiation alone, little evidence of repopulation was seen and immunofluorescent qualitative observations of gut and lung, and quantitative data in the spleen, confirmed these findings. After transfer of 50 million lymph node cells, very few immunoglobulin-containing cells were seen in the gut or bronchial lamina propria. These results suggest that there may be a common mucosal immunologic system, and that repopulation of gut and lung lamina propria may be through the organized lymphoid tissue therein. (auth)

1178 CYCLOTRON FAST NEUTRON RBE FOR VARIOUS NORMAL TISSUES. Geraci, J. P.; Jackson, K. L.; Christensen, G. M.; Thower, P. D.; Fox, M. S. (Univ. of Washington, Seattle). Radiology; 115: No. 2, 459-463(May 1975).

The relative biological effectiveness (RBE) values of fast neutrons as a function of dose in the range of dose per fraction being used clinically are reported for effects on several normal mouse tissues. The specific tissues examined were: thymus, spleen, white blood cells (WBC), testes, and small intestine. The RBE values for damage to the thymus (1.2), spleen (1.2), WBC (1.0), and testes (3.0) were independent of neutron dose size. In contrast, the RBE for the small intestine varied between 2.7 and 3.4 and was dependent on the size of the neutron dose. The RBE for intestinal death (2.4) and hematopoietic death (1.1) also is reported. (auth)

1179 ADRIAMYCIN CARDIOMYOPATHY: ENHANCED CARDIAC DAMAGE IN RABBITS WITH COMBINED DRUG AND CARDIAC IRRADIATION. Eltringham, J. R.; Fajardo, L. F.; Stewart, R. (Univ. of Utah, Salt Lake City). Radiology; 115: No. 2, 471-472(May 1975).

Rabbits received either no treatment; a single radiation dose; protracted low-dose adriamycin; combined cardiac irradiation and low-dose adriamycin; or protracted high-dose adriamycin. More severe myocardial lesions (similar to those in high-dose adriamycin groups) developed in rabbits receiving combined treatment. Pericardial effusions and fibrosis were more common in the combined treatment group. (auth)

Invertebrates

1180 (COO-3133-11) USE OF MOLECULAR HYBRIDIZATION TO EXPLORE GENETIC RELATIONSHIPS. Progress Report, July 1, 1974-March 31, 1975. Atwood, K. C. (Columbia Univ., New York (USA). Dept. of Human Genetics and Development). 1975. Contract AT(11-1)-3133. 11p. Dep. NTIS $4.00.

Progress is reported on DNA distribution in pygmy chimpanzees, mountain gorillas, catarrhine monkeys, baboons, spider monkeys, and marmosets; chromosome mapping of human 5S RNA using ^{3}H or ^{125}I labelled RNA; hybridization of ^{125}I-RNA to chromosomes in mice; mapping of low-multiplicity genes by hybridization in situ; technical improvements in iodination of RNA; formation of RNA aggregates; genetics of DNA and RNA in Drosophila; and x-radioinduced chromosomal aberrations in Drosophila. (HLW)

1181 SUPPRESSION OF MEDITERRANEAN FRUIT FLY IN TUNISIA: A NEW METHOD FOR AERIAL DISTRIBUTION OF STERILE FLIES FROM FIXED WING AIRCRAFT. Howell, J. F. (USAID, Tunis); Cheikh, M.; Salah, H. B.; Crnjanski, P.; Pils, W.; Harris, E. J. J. Econ. Entomol.; 68: No. 2, 244-246(15 Apr 1975).

Paper tubes, each containing 20,000 sterile Mediterranean fruit flies, Ceratitis capitata (Wiedemann), were designed so they would open automatically some distance from the aircraft from which they were released. The flies were not damaged by the accelera-

tion or by the turbulent air currents caused by the aircraft. This new compact packaging makes it possible for small aircraft to carry large numbers of the flies. Also, there was an increase in the trap catch of these aerially released flies compared with the catch of similar ground-released flies (0.059 vs. 0.027 per cent recovery) and a 20 per cent more uniform catch/trap. The improved distribution may have accounted for the higher trap catches . The paper tubes are simple, economical, and seem applicable to a wide range of insects. (auth)

1182 SUPPRESSION OF THE MEDITERRANEAN FRUIT FLY IN TUNISIA WITH RELEASED STERILE INSECTS. Cheikh, M. (Institut National de la Recherche Agronomique, Tunis); Howell, J. F.; Harris, E. J.; Salah, H. B.; Soria, F. J. Econ. Entomol.; 68: No. 2, 237-243(15 Apr 1975).

The Government of Tunisia, U. S. Agency for International Development, and U. S. Department of Agriculture cooperatively developed a program for suppression of Ceratitis capitata (Wiedemann) in Tunisia. Mediterranean fruit flies were reared on an artificial diet, sterilized with 10 krad irradiation from a cobalt source, and the emerged adults were marked and then distributed by hand throughout the release area, 600 ha in the vicinity of Porto-Farina. Some aerial releases were made late in the season. Winter larval hosts were removed to lower the overwintering population, and sterile fly releases were begun early (Mar. 1) to prevent fertile matings of flies that emerged during warm winter days. All fruit on the periphery of the release area was sprayed periodically (5 applications), as was the major fruit-growing areas within the region but outside the test zone, to minimize the possibility of fertile flies entering the release area. Daily from March to November, ca. 1,000,000 sterile flies were released. Trap catches indicated that the suppression obtained was about equal to that obtained using poison bait sprays. The early preferred host crops had no or negligible infestation (loquats, apricots, early peaches, and figs). The infestation of preferred summer fruits (peaches and figs) was reduced but not controlled. Less susceptible summer fruits were seldom infested. The estimated population was ca. 82.3 percent lower than in the previous year when no releases were made. Isolation and sterile fly distribution was inadequate to completely suppress the Mediterranean fruit fly population. (auth)

1183 RADIOSENSITIVITY OF THE LONGHEADED FLOUR BEETLE. Brower, J. H. (Agricultural Research Services, Savannah). J. Econ. Entomol.; 68: No. 2, 220-222(15 Apr 1975).

A dose of gamma irradiation of 10 krad to eggs of Latheticus oryzae Waterhouse prevented the development of adults; a dose of 5 krad to larvae prevented development. Some adults emerged from pupae treated with 7 doses ranging from 5 to 100 krad, but longevity was greatly reduced except for those from pupae treated at 5 krad. Adult males were sterilized by a dose of 20 krad, and adult females by a dose of 10 krad. The longevity of treated adults was significantly reduced; none survived as long as 3 wk after exposure to 20 krad. (auth)

1184 EFFECT OF GAMMA RADIATION ON DDT RESISTANCE AND DDT-DEHYDROCHLORINASE LEVELS IN MUSCA DOMESTICA. Philip, H. G. (Univ. of Alberta, Edmonton). J. Econ. Entomol.; 68: No. 2, 135-139(15 Apr 1975).

During DDT-resistant house fly development, the amount of DDT-dehydrochlorinase increased sharply during the larval stages, decreased markedly at pupation, and increased again upon adult eclosion. None was detected in eggs or in day-old larvae. The protein synthesis inhibitors puromycin, actinomycin D, and chloramphenicol reduced the levels of alpha-glycerophosphate dehydrogenase and DDT-dehydrochlorinase in teneral adult flies. In 4 to 5-day-old larvae exposed when less than 24 h old to 6, 12, 18, or 24 krad of gamma radiation, DDT-dehydrochlorinase specific activity decreased as the radiation dose increased. After 1 additional day of development, DDT-dehydrochlorinase activity decreased in both irradiated and nonirradiated larvae but the decrease was less in irradiated larvae exposed to greater doses of radiation. DDT-dehydrochlorinase specific activity in adults irradiated as 5 to 6-day-old pupae with the aforementioned doses of gamma radiation was unaffected by radiation. However, gamma-irradiated adults showed slight increased resistance to topically applied DDT. (auth)

1185 EXCISION REPAIR IN TETRAHYMENA: EVENTS FOLLOWING REFEEDING OF STARVED UV-IRRADIATED CELLS. Mowat, D.; Pearlman, R. E. (York Univ., Toronto). Photochem. Photobiol.; 21: No. 1, 5-11(Jan 1975).

Starvation of early-log-phase Tetrahymena pyriformis in nonnutrient phosphate buffer for 24 h resulted in a 40% increase in cell number, as well as a complete cessation of DNA synthesis. Low levels of DNA synthesis were detectable between 1 and 2 h after starved cells were transferred to a nutrient medium. Larger amounts of DNA synthesis were detected after the first 2 h of refeeding, and one round of replication was completed 4.5 h after refeeding. Damage, caused by sublethal doses of uv radiation (254 nm) administered just prior to refeeding, to the DNA of starved Tetrahymena appeared to be corrected by an excision-repair process after refeeding of starved, irradiated cells. Changes in buoyant density of DNA synthesized, rate of DNA synthesis, and the chromatographic distribution of photoproducts were investigated following refeeding of starved, irradiated cells. Excision repair began 1 h after refeeding and appeared to be essentially complete within 7 h. During this time, thymine dimers produced by irradiation were removed. Semiconservative DNA synthesis commences 2 to 3 h after the first appearance of excision repair. In addition, between 3 and 8 h after refeeding, the rate of DNA synthesis in irradiated, refed cultures was much lower than the rate of DNA synthesis in unirradiated, refed cultures. Also, the specific activity in vitro of DNA polymerase from irradiated refed cells was very much greater than that of polymerase from unirradiated, refed cells. (auth)

1186 EFFECTS OF X RAYS ON NUCLEIC ACID METABOLISM DURING CLEAVAGE AND GASTRULATION IN PLEURODELES WALTII EGGS. Alexandre, H. (Univ., Brussels). J. Embryol. Exp. Morphol.; 32: No. 1, 147-157(Aug 1974).

X irradiation produces a rapid and substantial decrease in DNA synthesis in cleaving eggs of Pleurodeles, as shown by thymidine incorporation experiments; this decrease is presumably due to the arresting of the cell cycle in many blastomeres. DNA replication is partly resumed at the late blastula stage after irradiation at the 2- to 4-cell stage. The present work demonstrates a high radiosensitivity of the metabolic pathway leading to the incorporation of uridine into DNA; this could be the result of the inhibition of the activity or the synthesis of such enzymes as ribonucleotide reductase, thymidylate synthetase, and CTP synthetase. The radiosensitivity of this metabolic pathway becomes lower after gastrulation. Finally, irradiation strongly inhibits the synthesis of new RNA species at gastrulation, but seems to have no effect on heterodisperse RNA (mRNA) synthesis during cleavage. The results are discussed in relation to the biochemistry of early stages of development in amphibians. (auth)

1187 COMPARATIVE ANALYSIS OF THE RADIATION AFTER-EFFECT OF VARIOUS TYPES OF MUTATIONS IN DROSOPHILA FEMALES. Tikhomirova, M. M. (Leningrad State Univ.). Genetika; 11: No. 2, 125-131(Feb 1975). (In Russian).

By the method of successive effect of x rays at a dose of 1000 R and of high temperature (37° C) on females of Drosophila melanogaster line $yw/y^{+}Y$, different kinds of mutations were induced: dominant lethal, non-disjunction, and X-chromosomal loss, recessive sex-linked lethal mutation. Radiation after-effect (the appearance of potential damages) was demonstrated and this effect was estimated as a surplus of the mutation rate. It is shown that the life period of potential damages depends on their genetic nature. The chromosome breaks exist in an open state during one hour after the x irradiation independently on the type of mutations. The potential gene changes (or microaberrations) are of short-life types and can be detected only by the temperature treatment immediately after the irradiation. It is suggested that the radiation after-effect combined with the heat treatment within 1 hour after the irradiation indicates potential chromosome breaks in Drosophila mutations. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 744, 747, 778, and 1119.

1188 (BNWL-B-389(Supp.)) DACRIN: A COMPUTER PROGRAM FOR CALCULATING ORGAN DOSE FROM ACUTE OR CHRONIC RADIONUCLIDE INHALATION; MODIFICATION FOR GASTROINTESTINAL TRACT DOSE. Strenge, D. L. Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-1830. 125p. Dep. NTIS $5.45.

The computer program DACRIN was used with the lung model proposed by the ICRP Task Group on Lung Dynamics to calculate the effective dose to the respiratory tract and other organs following either acute or chronic inhalation of radionuclides. The computer program has been expanded to calculate doses to the G. I. tract compartments using the lung model as the input mechanism. (auth)

1189 (COO-1826-32) URANIUM MINER LUNG CANCER STUDY. Progress Report, March 15, 1974—March 15, 1975.

Saccomanno, G. (Saint Mary's Hospital, Grand Junction, Colo. (USA). Dept. of Pathology). 1975. Contract AT(11-1)-1826. 9p. Dep. NTIS $4.00.

The three projects supported by Atomic Energy Commission are of utmost importance and consist of: collection of material from uranium miners known to have cancer of the lung into a tumor registry; regression study of sputum cytological findings in uranium miners who showed marked atypical squamous cell metaplasia and have quit smoking cigarettes, mining, or both. This study was active for the last six years and some interesting information is being accumulated. Manual of Pulmonary Cytology. Approximately 60,000 sputum samples have been examined over the last 17 years in cases that showed normal cytology at the inception of study and subsequently developed carcinoma of the lung. (auth)

1190 NUCLEAR POWER PLANTS AND INFANT MORTALITY. An Analysis of the Arguments of Sternglass. Boeck, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Naturwiss. Rundsch.; 27: No. 10, 411-415(Oct 1974). (In German).

The much argued about thesis of Sternglass and its critical analyses is being widely covered by an interpretation of the lecture by P. Hull held in March 1972 in Los Angeles: "Sternglass: A Case History" (Conference on Nuclear Public Information). (GE)

1191 RADIOACTIVE EXPOSURE OF THE POPULATION BY CONTAMINATED AIR EMITTED FROM NUCLEAR PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Bonka, H.; Brenk, D.; Bruessermann, K.; Edelhaeuser, H.; Schwarz, G.; Vogt, K. J. Trans. Amer. Nucl. Soc.; 20: 432-435(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1192 TREATMENT BY INSERTION OF RADON NEEDLES, ON THE BASIS OF MATERIALS OF THE INSTITUTE OF ONCOLOGY, GLIWICE. Carcinoma of the Tongue and Floor of the Oral Cavity. Rattka, P. (Inst. of Oncology, Gliwice, Poland). Pol. Przegl. Radiol. Med. Nukl.; 38: No. 6, 745-754(1974). (In Polish).

Seventy-two patients with carcinoma of the tongue were treated, depending on the degree of advancement of the tumor, by insertion of radon needles. Five and ten-year results and treatment failures are discussed. The degree of advancement of the tumor and presence of metastases were the most frequent cause of treatment failure. The author postulates the necessity of removing lymph nodes in every case. Results of treatment of 18 patients with tumors of the floor of the oral cavity by radon needles are discussed. The histopathologic classification, therapeutic technique, and advancement of the lesions are described. Results after 5 and 10 years and complications are discussed. (auth)

Animals

1193 EFFECTS OF TRITIATED WATER ON THE DIVISION RATE OF PARAMECIUM AURELIA. Bai, A. R. K.; Manjula, M. K. (Bangalore Univ., India). Indian J. Exp. Biol.; 12: No. 5, 410-411(Sep 1974).

The effects of endogenous β irradiation on the division rate of P. aurelia have been studied, using tritiated water of different specific activities. The fission rate is dosage dependent. There is a minimum, an optimum, and a maximum radiation dose. (auth)

1194 THE EFFECT OF TRITIATED WATER ON THE DEVELOPMENT OF THE FETAL HEMOPOIESIS IN RATS. Haas, R. J.; Schreml, W. (Ulm Univ. (F. R. Germany). Dept. Kinderheilkunde, Ulm Univ. (F. R. Germany). Abt. Klinische Physiologie). Blut; 29: No. 2, 96-107(Aug 1974). (In German).

The effect of a continuous infusion of various doses of tritiated water (HTO) to rats from day 9 of pregnancy until term was studied in the offspring. Since tritium is the principal radionuclide released from thermonuclear tests its effects on the most sensitive phases of mammalian life, the fetus, seemed worth investigation. Our study was undertaken to approximate a realistic situation, the consequences to the development of fetal hemopoiesis after maternal ingestion of HTO during pregnancy. Doses of 5,800 μCi/day resulted in a significant impairment of the development of fetal hemopoiesis in the newborn animals, during the entire observation period of 3 weeks after birth. Litter size and post-natal death rate was not altered. Smaller doses than 5,800 μCi/day had no significant effects on the hemopoiesis of the offspring except a decrease of lymphocytes demonstrable after 2,800 μCi/day HTO. A comparison with dates obtained after ^{3}H-thymidine (^{3}H-TdR) infusion reveals that tenfold higher doses of HTO are necessary to demonstrate similar effects in the offspring. The mechanisms for this phenomenon are discussed, and it is concluded that the final position of the tritium compound in the cells is the most important factor in the observed radiobiological effect. (auth)

1195 DIFFERENT ACTION OF SUICIDAL DOSES OF TRITIATED THYMIDINE AND HYDROXYUREA ON MURINE HAEMOPOIETIC CELLS. Schreml, W.; Bock, O.; Bock, E.; Helt, W.; Kubanek, B. (Univ., Ulm, Ger.). Cell Tissue Kinet.; 7: No. 6, 517-527(Nov 1974).

In order to gather information on the factors that cause the different action of suicidal doses of tritiated thymidine (^{3}H-TdR) and of hydroxyurea on murine stem cells, the incorporation of ^{3}H-TdR into DNA of bone marrow and spleen cells was studied. Continuous death of labelled cells after suicidal ^{3}H-TdR was indicated by a more pronounced decline of total DNA-bound radioactivity in bone marrow and spleen cells compared to that in control animals which had received tracer doses of ^{3}H-TdR. Extensive and rapid loss of DNA-bound radioactivity occurred in ^{3}H-TdR labelled animals after hydroxyurea treatment indicating an instantaneous and highly effective killing of labelled cells. After double labelling of DNA with ^{3}H-TdR and ^{125}iodo-deoxyuridine (^{125}I-UdR), the decline of the ratio of DNA-bound ^{125}I to DNA-bound ^{3}H after suicidal ^{3}H-TdR indicated prolonged tritium reutilization. Following hydroxyurea, reutilization was completed within the first 12 hr after drug administration. These findings explained in part the slow recovery of different stem cell compartments after suicidal ^{3}H-TdR on the basis of protracted tritium reutilization as compared to the fast recovery that followed the rapid action of hydroxyurea. (auth)

1196 ACUTE LETHALITY IN GUINEA PIGS FOLLOWING RESPIRATORY EXPOSURE TO ^{85}Kr. Kirk, W. P.; Rehnberg, B. F.; Morken, D. A. (Environmental Protection Agency, Research Triangle Park, NC). Health Phys.; 28: No. 3, 275-284 (Mar 1975).

Guinea pigs were exposed via the respiratory tract for 12 hr to ^{85}Kr concentrations ranging from 54 to 520 μCi/cm^3 and observed for 60 days or until death, whichever occurred first. The 30-day median lethal exposure was 4450 (μCi/cm^3) hr, which corresponds to estimated doses of 316 rads to the bone marrow, 340 rads to the whole body, and 7876 rads to the lungs. The marrow and whole-body doses, times of death, and the gross clinical and necropsy observations were consistent with death by the hematopoietic syndrome but lung injury was dominant in animals that survived for more than 30 days. The whole-body and marrow doses delivered at the median lethal exposure and the observed times of death are similar to those reported in x- or γ-radiation lethality studies. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 2924.

1197 (AED-CONF-74-221-008) EVALUATION OF THE EFFICIENCY OF RADIATION PROTECTION CONTROL FOR THE PURPOSE OF INCORPORATION MONITORING. Erlenbach, H. R. (Zentralstelle fuer Sicherheitstechnik, Strahlenschutz und Kerntechnik des Landes Nordrhein-Westfalen, Duesseldorf (F. R. Germany)). 1974. 14p. (In German). INIS.

From 15th annual meeting on "the authorized physician within the meaning of the radiation protection laws"; Karlsruhe, F. R. Germany (14 Jun 1974).

The efficiency of incorporation controls, based on ten years experience in radiation protection by the Zentralstelle fuer Sicherheitstechnik, Strahlenschutz, und Kerntechnik acting on behalf of the office for factory inspection of the Land Northrhine-Westphalia was evaluated. The Zentralstelle controls persons occupationally exposed to ionizing radiation, e.g., persons handling unsealed radioisotopes or nuclear fuels (except those working in the KFA Juelich). The main physical methods applied are whole-body counting, urine analysis, and fluorimetric determination of uranium. The doses due to internal irradiation are then calculated on the basis of ICRP recommendations. Biological methods do not at present form part of the routine measures and are only applied in cases where there is the possibility of an accidental, unusually high radiation exposure. (GE)

1198 AN APPROXIMATION FOR IMPROVING THE ACCURACY OF COMPARTMENTAL ANALYSIS AFTER INTRAVENOUS ^{133}Xe. Kantlehner, R.; Pfeifer, K. J.; Schmidt, K. R. (Muenchen Univ. (F. R. Germany). Klinik und Poliklinik fuer Radiologie). Fortschr. Geb. Roentgenstr. Nuklearmed.; 122: No. 2, 124-126 (Feb 1975). (In German).

Perfusion of transplanted kidneys was studied by intravenous injection of ^{133}Xe with subsequent graphic compartmental analysis of time-activity curves. Where there is poor perfusion of the renal cortex, it is not possible to obtain a half-value time for the first compartment—which is the significant measure for special blood flow—since few points are available for the tail end of the curve. A correction is described which produces an approximation to a bolus, based on the time-activity curve of the expired air. If this is applied to the proximal part of the time-activity curve, with respect to background activity, compartmental analysis can be performed with a higher degree of accuracy in the calculation of renal perfusion. (auth)

1199 TOTAL BODY RETENTION OF ORALLY ADMINISTERED ^{47}Ca IN PRIMARY HYPERPARATHYROIDISM. Mallette, L. E. (National Institutes of Health, Bethesda, MD); Sode, J. E.; Marx, S. J.; Georges, L. P.; Aurbach, G. D. J. Clin. Endocrinol. Metab.; 40: No. 4, 582-588(Apr 1975).

Using a whole-body radiation detector, the total-body retention of ^{47}Ca 7 days after oral administration of the isotope to patients with various disorders of calcium metabolism was measured. The percent retention of ^{47}Ca given with 90 mg of unlabeled (carrier) calcium varied with the calcium metabolic status as follows: normals (n equals 14), 33–43 percent (mean 38); primary hyperparathyroidism (n equals 28), 32–74 percent (mean 52); idiopathic hypercalciuria (n equals 9), 34–49 percent (mean 42); and hypercalcemia of other etiology (n equals 3), 23–26 percent (mean 25). Almost half (13/28) of those with hyperparathyroidism showed a retention above 55 percent, distinguishing them from subjects with idiopathic hypercalciuria. Retention of ^{47}Ca correlated poorly with clinical measures of severity of hyperparathyroidism. When isotope was diluted with a smaller amount of carrier calcium (20 mg), retention was increased in normals (n equals 5) to 46–54 percent (mean 50) and in hyperparathyroidism (n equals 5) to 64–87 percent (mean 73). After surgical cure of hyperparathyroidism retention of isotope returned toward normal in 5 of 7 subjects. Whole-body retention of orally administered ^{47}Ca may prove useful in detecting hyperparathyroidism in subjects with mild hypercalcemia or hypercalciuria. (auth)

1200 RADIONUCLIDES IN THE AUTOPSY SAMPLES FROM THOROTRAST PATIENTS. Molla, M. A. R. (Atomic Energy Centre, Dacca, Bangladesh). Health Phys.; 28: No. 3, 295-297 (Mar 1975).

Reference is made to work reported by Goldin et al. (Health Phys.; 22: 471 (1972)) concerning radionuclide kinetics in thorotrast patients and compared with similar work reported by the present author (Molla, M. A. R. Radiation Doses from Thorotrast Myelography. Thesis. Univ. of Toronto. (1971) and McNeill et al. Health Phys.; 24: 403 (1973)). It is stated that most of the data of ^{232}Th to daughter ratios from both sources are in good agreement but that there appears to be some discrepancies in the observations and interpretations of Goldin et al. relating to data on cortical bone or marrow-free bone and also in the interpretation on the difference in the observed activities of ^{228}Ra and ^{228}Th in the samples. It is shown that the reported activity of ^{232}Th in the cortical bone is probably due to contamination from the bone marrow, a part of the reticuloendothelial system and/or due to the injection of a chemically less stable thorotrast having a component of ionic ^{232}Th, since it is unlikely that thorotrast would ever be incorporated into the mineral bone. (UK)

1201 STUDY OF SOME FACTORS AFFECTING ^{86}Rb UPTAKE BY NORMAL ERYTHROCYTES. Plagne, R.; Bidet, J. M.; Chollet, P.; Bard, J. J.; Sauvezie, B. (Institut National de la Sante et de la Recherche Medicale (INSERM), 63-Clermont-Ferrand (France)). Compt. Rend. Soc. Biol.; 168: No. 2, 289-294 (1974). (In French).

Blood specimens from 80 healthy subjects were tested. Haematocrit was an important parameter to know the exact percent of 86 Rb uptaken by red cells. The mean corpuscular volume was not. The red cell suspension in autologous plasma was more advisable than culture medium (Eagle). Inhibition by 50% of the Na-K pump by 1×10^{-7} ouabain was found, in comparison with results of other reports. (FR)

1202 POWER LAWS IN COMPARTMENTAL ANALYSIS. Part I. A Unified Stochastic Model. Marcus, A. H. (Univ. of Maryland, Baltimore). Math. Biosci.; 23: No. 3-4, 337-350(Apr 1975).

The transport of radioactive tracers and trace pollutants through the body is usually modeled as a multi-compartment linear differential system with constant exchange rates. The specific activity curves must then necessarily be mixtures of exponentials and non-negative integer powers of the time since injection. This is inconsistent with observations on many systems, which exhibit specific-activity curves with either negative powers of time or arbitrary non-integer positive powers of time with an exponential modification (Gamma densities). A physiologically plausible random-walk model is proposed by which a single four-parameter compound Poisson process for the residence time of a molecule of tracer in a compartment can fit all of the observed types of specific activity curves. The parameters have direct interpretations in terms of an age-dependent molecular exchange rate between compartments. Multi-compartment systems can be similarly modeled as a Markov renewal process. (auth)

1203 AEROSOL CHARACTERIZATION AND DEPOSITION. Morrow, P. E. (Univ. of Rochester, NY). Amer. Rev. Respirat. Dis.; 110: 88-99(1974).

The basic properties and descriptions of aerosol distributions and the principal determinants and characteristics of aerosol deposition in the human respiratory system were reviewed. An overview of the appropriate theoretic considerations and research data was presented for those concerned with inhalation therapy. (auth)

Animals

Refer also to abstract 1145.

1204 (COO-2269-8) KINETIC AND BIOCHEMICAL STUDIES ON TUMOR GROWTH. Comprehensive Progress Report, October 1, 1967–April 1, 1975. Dethlefsen, L. A. (Utah Univ., Salt Lake City (USA). Coll. of Medicine). 1975. Contract AT(11-1)-2269. 16p. Dep. NTIS $4.00.

The growth kinetics of four lines of the C3H mammary tumor have been studied in detail by standard autoradiographic procedures in combination with volumetric growth curve analysis. Thus, such parameters as volumetric doubling time, mean cell generation time, growth fraction, and cell loss have been measured. Two of these lines (Slow and S102F) are currently being used for studying hormone responsiveness both in vivo and in vitro and the perturbed kinetics following insults with therapeutic agents. The respective values for the above parameters are: Slow; 21.0 days, 34 hours, 0.20, 9 percent per day, and S102F; 2.5 days, 17 hours, 0.60, 27 percent per day. A direct method (^{125}I-IUdR Method) for measuring cell loss has also been developed. This method consists of injecting mice with ^{125}I-IUdR and then measuring the loss of ^{125}I-activity from the tumor. This method has been used in tumors from three of the lines and the results correlate with cell loss as defined by standard procedures. The antigenic status of these tumors has been studied as one possible factor underlying the different growth kinetics. The mouse's immunological sys'em was either suppressed (thymectomy and whole-body x-irradiation) or stimulated (previous exposure to tumor cells) and the percent takes, latent period, and growth rates measured. There was no evidence for a strong antigenic factor in any of these tumors. Hydroxyurea is being used as a tool for studying the perturbed cellular kinetics of the duodenum and the Slow and S102F tumors. The methods used are autoradiography, volumetric growth curve analysis, and measurements of the rates of DNA synthesis. Single doses (3 mg/gm body wt.) of hydroxyurea kill the S-phase cells, and produce a temporary G_1/S block, some reduction in the cell-cycle times, and an increase in the growth fraction. Results from the two-dose and multiple-dose experiments show that the initial recovery kinetics following a single dose can be used to predict the time when the second dose of hydroxyurea will be most effective. In vitro lines have been established for both the Slow and S102F in vivo lines, and the hormone effects (i.e., incubation with insulin, corticosterone, and prolactin) on growth have been studied. Insulin had no effect but large doses of corticosterone (20 mu g/ml and greater) were inhibitory and prolactin appeared to partially reverse these effects in the Slow line. (auth)

1205 (ORO-4106-15) STUDY OF THE INFLUENCE OF HORMONES ON THE TRANSPORT OF CATIONS INTO AND OUT OF BONE. Progress Report. (North Carolina Univ., Chapel Hill (USA). Dept. of Surgery). 1 Jul 1975. Contract AT(40-1)-4106. 17p. Dep. NTIS $4.00.

Studies were conducted on daily changes in plasma calcium, phosphate, and their concentrations of ^{45}Ca and ^{32}P as related to plasma gastrin and calcitonin. Plasma gastrin and calcitonin concentrations rose sharply after feeding when plasma Ca and P concentrations were already low. Parathyroid transplantation to sites away from the thyroid delayed the expected rise in plasma gastrin, and delayed the expected fall in plasma ^{45}Ca and ^{32}P. Plasma changes due to parathyroid hormone and calcitonin given in combination or in sequence were also studied. (HLW)

1206 DECORPORATION OF ^{241}Am IN BEAGLES BY DTPA. Lloyd, R. D.; McFarland, S. S.; Taylor, G. N.; Williams, J. L.;

Mays, C. W. (Univ of Utah, Salt Lake City). Radiat. Res.; 62: No. 1, 97-106(Apr 1975).

Chelation treatments using daily subcutaneous injections of $ZnNa_3$-DTPA were begun 2 wk after the intravenous administration of 0.3 muCi/kg ^{241}Am citrate to six female beagles averaging 505 days of age. Retention of americium in the liver and in nonliver tissue (mainly skeleton) was followed serially in the living dogs by a combination of total-body and partial-body counting. During the first 13 mo of DTPA therapy, the removal of ^{241}Am from two dogs given one DTPA injection each day of 0.027 or 0.034 mmole/kg was similar to the fraction removed from two other dogs given a similar total of 0.035 or 0.037 mmole/kg/day in five fractionated injections each day. Increasing the daily amount of DTPA to 0.36 and 5.0 mmole/kg/day in the two remaining dogs only slightly increased the removal of ^{241}Am. At the beginning of chelation therapy, all six dogs averaged 43 percent of the injected ^{241}Am in the liver and 46 percent in nonliver tissue. ^{241}Am retention in liver at 2 mo of therapy was about 2 percent of pretreatment liver retention, decreased to roughly 1 percent of pretreatment retention by 5 mo of DTPA administration, and was undetectable at 13 months. Nonliver retention at 2 mo was 53 percent of pretreatment retention in nonliver tissue, at 5 mo averaged about 40 percent, and had decreased to 27 percent of pretreatment values by 13 mo of chelation therapy. In contrast, for beagles of our colony not treated with DTPA, ^{241}Am in the liver and in nonliver tissue exhibited a biological half-time in the order of 10 yr. (auth)

1207 THE EFFECT OF CADMIUM APPLICATION ON THE CHICKEN. P. 2. The Distribution of Cadmium in the Organism. Hardebeck, H.; Krampitz, G. (Bonn Univ. (F. R. Germany). Inst. fuer Anatomie, Physiologie und Hygiene der Haustiere); Suelz, M. Arch. Gefluegelk.; 38: No. 3, 100-103(1974). (In German).

The highest proportion of orally applied ^{115m}Cd to broilers was accumulated in the kidneys. ^{115m}Cd was also found in larger quantities in the liver. Low concentrations of radioactive Cd were observed in the skeletal muscles. Animals being treated with additional 3 ppM of nonradioactive Cd accumulated essentially more ^{115m}Cd in organs and tissues. The application of ^{115m}Cd in the lungs resulted in a higher resorption rate. The incorporation of ^{115m}Cd in the eggs after oral application could not be observed, however, i.v. injections caused a transition of ^{115m}Cd into the yolk. (auth)

1208 ACCUMULATION OF CESIUM ISOTOPES IN ANIMAL MUSCLES, AS SEEN FROM THE POINT OF VIEW OF MEAT HYGIENICS. Szentkuti, L.; Giese, W. (Tieraerztliche Hochschule Hannover (F. R. Germany). Physiologisches Inst.). Fleischwirtschaft; 54: No. 7, 1231-1232(1974). (In German).

Cesium isotopes accumulate in muscle cells by means of an active transport mechanism corresponding to that of K in exchange for Na. This Na/Cs-pump is located in the sarcolemma. The energy necessary for the Cs-transport into the muscle cell is obtained from the cell's metabolism. Post mortem the energy production and hence the active transport of Cs^+ into the muscle cell is stopped and differences of Cs-concentration between intracellular and extracellular fluid become smaller by diffusion until equilibrium is reached. Isolated muscle proteins are not capable of binding cesium. Therefore, only the living muscle is a critical organ for cesium isotopes. (auth)

1209 DEPOSITION OF CALCIUM PHOSPHATE INTO DENTIN AND ENAMEL AS SHOWN BY RADIOAUTOGRAPHY OF SECTIONS OF INCISOR TEETH FOLLOWING INJECTION OF ^{45}Ca INTO RATS. Munhoz, C. O. G.; Leblond, C. P. (McGill Univ., Montreal, Quebec (Canada). Dept. of Anatomy). Calcified Tissue Res.; 15: No. 3, 221-235(1974).

To find out whether the calcium phosphate of dentin and enamel is elaborated in the cells prior to passing into the organic matrix or is initially deposited into the matrix, rats were injected intravenously with ^{45}Ca and killed 30 sec or 5 min later by glutaraldehyde perfusion; semithin sections of the undecalcified incisor teeth were then radioautographed for detection of the incorporated ^{45}Ca. Rat incisor teeth were selected since there is evidence that the calcium they take up is stable; that is, not subject to significant loss by exchange or by other physiochemical processes. When dentin is examined after ^{45}Ca injection, the maximum radioautographic reaction is observed next to the junction with predentin and a gradual decrease up to the dentin enamel border. No radioactivity is detected in odontoblasts. These observations are interpreted as indicating that the initial site of calcium phosphate deposition is in the matrix of dentin. In the enamel, the radioautographic reaction is spread fairly uniformly throughout the matrix, with a weak reaction over ameloblasts attributed to radiation scatter. The interpretation is again that calcium phosphate is deposited into the matrix; and, furthermore, that this deposition begins as soon as the matrix is laid down and continues at about the same rate up to an advanced stage of mineralization. (auth)

1210 IN VIVO KINETIC BEHAVIOR AND WHOLE-BODY PARTITION COEFFICIENTS FOR ^{85}Kr IN GUINEA PIGS. Kirk, W. P.; Morken, W. P. (Environmental Protection Agency, Research Triangle Park, NC). Health Phys.; 28: No. 3, 263-273 (Mar 1975).

The whole-body kinetic behavior of ^{85}Kr was investigated by counting the radiation emitted from guinea pigs breathing an ^{85}Kr-air mixture. Animals were counted during saturation until equilibrium was reached when the animals were permitted to breathe uncontaminated air while counting continued until pre-exposure background was reached. Saturation and desaturation curves were multiexponential in form and usually had four components with half-times of 0.25 to 2.2 min, 6 to 12 min, 21 to 42 min, and 78 to 88 min. The whole-body weight partition coefficient was determined, concurrently with the kinetics studies, to be 0.1444 (S. D. = 0.0148). (auth)

1211 IN VIVO SOLUBILITY OF ^{85}Kr IN GUINEA PIG TISSUE. Kirk, W. P.; Parish, P. W.; Morken, D. A. (Environmental Protection Agency, Research Triangle Park, NC). Health Phys.; 28: No. 3, 249-261(Mar 1975).

The theory of ^{85}Kr solubility in the body is discussed and a weight partition coefficient, equal to the Ostwald coefficient divided by absorber density, is defined to facilitate study of solubility in intact tissue and dose calculations. In vivo weight partition coefficients were determined in guinea pigs for blood and 22 other organs and tissues using a dual-isotope technique that permits simultaneous determinations for whole and bloodless tissue. The highest coefficients found for bloodless tissue were: omental fat (0.421); subcutaneous fat (0.405); thymus (0.259); lymph nodes (0.138); bone marrow (0.134); and adrenals (0.102). In general, the in vivo coefficients agreed well with predictions based on in vitro solubility determinations and the fat-protein-water composition of the tissue as reported in the literature. Ostwald coefficients were determined in vitro for ^{85}Kr into guinea pig blood, guinea pig brain homogenate, dog blood, cat blood, Chinese hamster blood, 0.9% NaCl solution, and 10% EDTA solution. (auth)

1212 TEMPORAL AND SPATIAL MARROW DOSE FROM $^{90}Sr-^{90}Y$ IN BEAGLES. A Measurement of Geometry-Distribution Factor. Momeni, M. H.; Jow, N.; Bradley, E. (Univ. of California, Davis). Health Phys.; 28: No. 3, 285-294(Mar 1975).

The local distribution of absorbed doses from $^{90}Sr-^{90}Y$ in skeleton is non-uniform because turnover patterns and bone architecture are not always uniform, even within a bone. The turnover rate of mineral matrix for cancellous bone is approximately 10 times that of the cortical matrix. Average doses based upon mean skeletal concentration are therefore misleading unless both the radionuclide turnover patterns and skeletal mineral distribution are quantified. Beagles fed ^{90}Sr from fetal age to early adulthood (1.5 yr) or throughout life were studied with respect to distribution of ^{90}Sr and calcium in selected bones. Local geometry within the bone, g_1, and microdistribution, $g_2(t)$, of $^{90}Sr-^{90}Y$ in beagle humeri were utilized to express geometric-microdistribution, G(t). The dose from $^{90}Sr-^{90}Y$ ranged from 5 to 10% in the most cancellous regions to 50 to 60% in the more cortical regions relative to D_0, where D_0 is the dose to a very small tissue filled cavity surrounded by infinitely thick soft tissue in all directions. The effective dose rate to red marrow thus appeared to diminish more rapidly than the dose rate to a significant fraction of osteoid cells in compact bone. These temporal and spatial dose patterns may be relevant to the etiology of pathologic changes in the tissues of irradiated bone. (auth)

Plants

Refer also to abstracts 1066 and 1258.

1213 (COO-1599-84(Pt. 4)) SODIUM: A FACTOR IN GROWTH OF BLUE-GREEN ALGAE. Ward, A. K. (Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology). 1974. Contract AT(11-1)-1599. 44p. Dep. NTIS $5.25. Thesis.

The response of heterocystous blue-green algae to varying concentrations of sodium was examined in axenic culture as well as in situ studies. Laboratory cultures of Anabaena cylindrica were treated with four concentrations of sodium and three concentrations of nitrate to determine the response in terms of rates of acetylene reduction, ^{14}C assimilation, excretion of organic carbon, concentration of chlorophyll a, particulate organic carbon, particulate organic nitrogen, and heterocyst and filament numbers. Natural populations of blue-green algae, predominantly Aphanizomenon sp., were used for sodium enrichment studies in

which carbon-14 assimilation and acetylene reduction provided a measurement of comparative photosynthetic carbon fixation and elemental nitrogen fixation, respectively. Cultures of Anabaena cylindrica with no Na^+ added suffered from decreased rates of acetylene reduction, ^{14}C assimilation, excretion of organic carbon as well as lower concentrations of chlorophyll a and particulate organic carbon compared to cultures supplied with 5, 10, and 50 mg Na^+ $liter^{-1}$. Sodium deficient cultures released a higher percentage of previously fixed carbon as organic carbon. No differences in any area measured were demonstrable among cultures grown with 5, 10, and 50 mg Na^+ $liter^{-1}$. High nitrate concentrations (20 mg NO_3 $liter^{-1}$) resulted in decreased rates of acetylene reduction and heterocyst numbers in sodium sufficient and sodium deficient cultures; however, decreased particulate organic nitrogen content at high nitrate levels occurred only in sodium deficient cultures. Higher percentages of excreted organic carbon occurred with increasing nitrate concentrations in sodium deficient cultures. Sodium enrichment of natural phytoplankton populations indicated increased photosynthetic carbon fixation with small additions of sodium (5 mg Na^+ $liter^{-1}$), whereas higher concentrations (50, 100, and 200 mg Na^+ $liter^{-1}$) elicited neither a stimulatory nor an inhibitory response. No increase in situ acetylene reduction rates occurred with additions of sodium. (auth)

1214 STUDIES ON LATERAL MOVEMENT OF ^{210}Pb IN WOODY STEMS. Patterns Observed in Dormant and Non-dormant Stems. Lepp, N. W.; Dollard, G. J. (Liverpool Polytechnic (UK). Dept. of Biology). Oecologia (Berlin); 16: No. 2, 175-184(1974).

Evidence was obtained for lateral transport of bark-applied ^{210}Pb from bark to wood in a range of tree species. This lateral redistribution was found to be independent of cambial reactivation, lead being recovered from bark and wood in the same proportions from dormant and nondormant shoots. The results are discussed in relationship to naturally occurring uptake of lead by stems. (auth)

1215 INVESTIGATIONS ON THE TRANSLOCATION OF ^{45}Ca IN APPLE TREES. P. 2. Transport to the Fruit and Distribution. Wieneke, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Arbeitsgruppe Radioagronomie). Gartenbauwissenschaft; 39: No. 1, 57-67(1974). (In German).

Three experiments were conducted with apple trees ("Cox Orange Pippin") to study the translocation of ^{45}Ca in relation to the time of root uptake. The labeled fruits were used to investigate the development of the Ca gradient from the fruit basis to the calyx end, reported several times in the literature on mature fruits. Based on autoradiograms of longitudinal apple sections during and at different times after termination of the labeling period, it can be concluded that a Ca gradient is not yet obvious at the beginning of the fruit development. This was furthermore substantiated by the analytical determination of the ^{45}Ca distribution in the tissue. The Ca gradient is rather induced with increasing fruit size by the decreasing rate of Ca translocation in connection with the simultaneous lateral deposition and fixation of Ca along its pathway to the upper fruit part. Strong fixation and precipitation in insoluble Ca fractions occurred mainly in the petiole, in the area of the core and vascular bundles of the fruit. There were no marked differences in the relative Ca distribution in different chemical fractions in the tissue of the lower or upper fruit half, neither in June immediately after translocation nor at harvest time. How far Ca is translocated in an essential amount to the fruit via the phloem remains still obscure. Girdling experiments did not yield clear-cut indications in this report. (auth)

1216 SEASONAL ACCUMULATION OF STRONTIUM-90 AND CESIUM-137 IN CERTAIN KINDS OF MEDICINAL PLANTS OF THE LEGUME FAMILY. Palamarchuk, A. S.; Bondarenko, V. E. (Tomsk State Univ., USSR). Dokl. Akad. Nauk BSSR; 19: No. 2, 184-185(Feb 1975). (In Russian).

Results are presented on studies of ^{90}Sr and ^{137}Cs in 10 species of medicinal plants of the legume family. It was established that strontium and cesium accumulate over the entire vegetation period. Therefore the maximum content of these elements is found at the end of the vegetative period. The species under study frequently accumulate strontium-90 a factor of 1.5 to 2 times greater than cesium-137. It was found that the various species accumulated varying amounts of radioelements in the roots. Plants of alpine clover contained the greatest amounts of cesium and strontium. The species under study were separated into three groups according to the amount of strontium and cesium. It was established that the plant species show a high selectivity in accumulating radioelements with a low content of radioelements in the soil. It is pointed out that it is necessary to take into account the natural radioactivity of medicinal plants in the characterization of their healing properties. (SJR)

Microorganisms

1217 ELECTRON MICROSCOPE AUTORADIOGRAPHIC INVESTIGATION OF THE ACCUMULATION OF ZINC-65 BY A SPECIES OF EUTREPTIA. Sims, M. A. (Univ. of Adelaide). Experientia; 31: No. 4, 426-427(15 Apr 1975).

The comparative accumulation of ^{65}Zn in the organelles of the single-celled alga, Eutreptia, was studied by means of electron microscopic autoradiography. The autoradiographs revealed that ^{65}Zn was accumulated by the organism and was localized in the chloroplasts. (ERB)

1218 DIURNAL CHANGES IN RADIONUCLIDES UPTAKE BY PHYTOPLANKTON IN SMALL SCALE ECOSYSTEMS. Yousef, Y. A.; Padden, T. J.; Gloyna, E. F. (Florida Technological Univ., Orlando). Water Res.; 9: No. 2, 181-187(Feb 1975).

A continuous release of ^{134}Cs and ^{85}Sr into a simulated river system was maintained for more than 3 weeks for the purpose of evaluating the influence of photosynthetic oxygen production on cesium and strontium uptake. The flow rates and radioisotope concentration were maintained at a constant input throughout the experiment. The flow-through time in the model river system was 6 h. Samples were taken from various stations every 4 h over a 36 h time interval. Temperature, dissolved oxygen, as well as other routine measurements were made. Samples were processed for plankton count and radioactivity in both the suspended phytoplankton and the water. The uptake of ^{134}Cs by phytoplankton was related to diurnal photosynthetic production of oxygen and a linear relationship exists between rate of change in ^{134}Cs concentration and the rate of net photosynthetic oxygen production. (auth)

New Tracer Techniques

Refer also to abstracts 172, 177, 848, 852, 853, 855, 940, 1066, 1067, 1113, 1180, 1202, and 1204.

1219 (COO-1668-62) MECHANISMS OF CALCIUM TRANSPORT IN SMALL INTESTINE. Progress Report, March 16, 1974–March 1, 1975. DeLuca, H. F. (Wisconsin Univ., Madison (USA). Dept. of Biochemistry). 1975. Contract AT(11-1)-1668. 8p. Dep. NTIS $4.00.

The macromolecular components of rat intestinal mucosal cytosol have been examined for their ability to bind radioactive 1,25-$(OH)_2D_3$ and radioactive 25-OH-D_3. In a variety of media the binding of these metabolites is found only to a 6S macromolecular component. No evidence for the existence of a 3.5S component which has been reported in the chick can be found in this species. The 6S component prefers 25-OH-D_3 to 1,25-$(OH)_2D_3$ and furthermore saturation experiments in vivo have shown that the 6S component does not bind 1,25-$(OH)_2D_3$ in vivo but instead binds the 25-OH-D_3. This allowed the conclusion that the 6S macromolecular component does not play a role in the 1,25-$(OH)_2D_3$'s function in stimulating intestinal calcium absorption. (auth)

1220 (COO-1668-68) MECHANISMS OF CALCIUM TRANSPORT IN SMALL INTESTINE. Overall Review of the Contract, September 1, 1972–March 1, 1975. DeLuca, H. F. (Wisconsin Univ., Madison (USA). Dept. of Biochemistry). 1975. Contract AT(11-1)-1668. 40p. Dep. NTIS $5.00.

During the past three years considerable advance has been registered in our understanding of the mechanism of intestinal calcium transport, which is activated in response to 1,25-$(OH)_2D_3$, the active form of the vitamin in the system. In brush borders isolated from vitamin D-deficient chicks, a 200,000 molecular weight protein has been found by disc gel electrophoresis which is not present in chicks given vitamin D. This protein does not bind calcium and does not possess calcium dependent adenosine triphosphatase activity. Following the administration of 1,25-$(OH)_2D_3$ to the deficient chicks this protein disappears from the disc gel profiles and a protein of molecular weight 220,000 appears in the gel profiles. This protein has been isolated and shown to possess calcium adenosine triphosphatase activity, alkaline phosphatase activity and it binds calcium. Work is progressing on the purification of these proteins with the ultimate aim of discerning what role they have in intestinal calcium transport. (auth)

1221 (COO-2423-3) STUDIES OF MEMBRANE STRUCTURE BY FREEZE-ETCHING. Progress Report, 1 July 1974–30 June 1975. Branton, D. (Harvard Univ., Cambridge, Mass. (USA). Biological Labs.). 1975. Contract AT(11-1)-2423. 6p. Dep. NTIS $4.00.

The structure and organization of biological membranes was studied using a variety of physical and biochemical techniques

together with electron microscopy and freeze-etching. These studies are providing knowledge relating the architecture of cellular membranes to their role in regulating the transport of molecules into and out of cells. A number of model systems, including Acholeplasma laidlawii and human erythrocyte membranes were proved to determine the distribution and asymmetry of component lipids and proteins. For this purpose, a novel combination of freeze-fracture and electron microscope autoradiographic techniques has been developed and is being tested. (auth)

1222 AUTORADIOGRAPHIC STUDY OF THE DISTRIBUTION OF ^{3}H-BILIRUBIN IN NORMAL RATS AND IN RATS WITH OBSTRUCTED BILE DUCT. di Mario Sposito, N.; Bertolini, B.; Buongiorno-Nardelli, M.; Hassan, G.; Marinucci, G.; Picardi, R. (Univ., Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 54: No. 6, 985-990(Jun 1973). (In Italian).

The histological study of intracellular transport and storage of bilirubin was carried out using the autoradiographic technique. Tritium-labeled bilirubin, prepared according to Grodsky's procedure, was injected into normal and obstructed rats. Percent of isotope loss in fixation and dehydration media was calculated and was found low enough on the whole not to impair the significance of the autoradiographic results. Autoradiographs of normal liver showed no definitive intracellular isotope polarization; in the liver of obstructed rats an accumulation of isotope in Kupffer cells was observed. In the kidney of obstructed rats a high concentration of 3H-bilirubin was observed in the epithelial cells of second order tubules. (auth)

1223 INJECTION OF RADIOACTIVE MATERIALS INTO AN IDENTIFIED AXON OF APLYSIA. Treistman, S. N.; Schwartz, J. H. (Public Health Research Inst. of the City of New York, Inc.). Brain Res.; 68: 358-364(1974).

Abdominal ganglia were removed from the mollusc, Aplysia californica, and techniques for injecting materials into the neurons are described. Tritium-labeled fucose, although converted to GDP-fucose, was not incorporated into glycoproteins in the axon, but tritium-labeled choline, injected intra-axonally, was just as efficiently converted to acetylcholine as was choline injected into the cell body. Data indicated that choline acetyltransferase, choline phosphokinase, and the enzymes catalyzing the oxidation of choline are present in the axon and can function there. (HLW)

1224 PATTERNS OF LABELING OF GERMINAL-CENTER CELLS WITH TRITIATED DEOXYCYTIDINE. Osogoe, B.; Tyler, R. W.; Everett, N. B. (Univ. of Washington, Seattle). J. Cell Biol.; 57: 215-220(1973).

One group of rats was injected intraperitoneally with ^{3}HCdR and a second group was injected with ^{3}HTdR. A third group received sheep red blood cells mixed with Freund's adjuvant in order to stimulate growth of germinal centers in the lymphoid tissues. Ten days later the third group was given ^{3}HCdR or ^{3}HTdR. The animals were killed at intervals up to 72 h after injection and the thymus, spleen, lymph nodes, and Peyer's patches of the intestine were prepared for autoradiography. The germinal center cells and thymus lymphocytes labeled much more intensely with ^{3}HCdR than with ^{3}HTdR. (auth)

1225 NEW TECHNIQUES IN TUMOR LOCALIZATION AND RADIOIMMUNOASSAY. Proceedings of a Conference Held in Philadelphia, Pennsylvania, May 3–5, 1973. Croll, M. N.; Brady, L. W.; Honda, T.; Wallner, R. J. (eds.). New York; John Wiley and Sons (1974). 230p. (CONF-7305114-).

Separate abstracts were prepared for the 18 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 1226–1243.

1226 FUNDAMENTALS OF RADIOIMMUNOASSAY. Goodfriend, T. L. (Univ. of Wisconsin, Madison). pp 1-8 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Radioimmunoassay is a technique combining the specificity of biological systems with the sensitivity of nuclear physics and engineering. It measures very small amounts of biologically active compounds. Its basic principles are as simple as the law of mass action, but the reagents are labile and susceptible to a large number of laboratory mishaps. Therefore the technique is empirical, the data interpretation must be flexible, and the role of human expertise appears to be inevitable. (auth)

1227 COMMERCIAL DEVELOPMENT OF THE RADIOIMMUNOASSAY KIT. Bruno, G. A. (E. R. Squibb and Sons, Inc., New Brunswick, NJ). pp 9-15 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The radioimmunoassay (RIA) technique provides an enormously sensitive yet practical tool to measure minute quantities of substances of medical interest. While the great majority of these assays are still restricted to research applications, a few have been developed on a commercial scale and put into routine clinical use. This process of commercializing the RIA technique is a vital link in the realization of the full potential of this invaluable tool. (ERB)

1228 MEASUREMENT OF PLASMA INSULIN AND PROINSULINLIKE COMPONENTS. Gorden, P.; Hendricks, C. M. (National Institutes of Health, Bethesda, MD). pp 17-24 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The procedures and clinical uses of the radioimmunoassay for the determination of insulin and proinsulinlike components are discussed. In a typical assay, the insulin is iodinated with Na ^{125}I at a specific activity of 100 to 200 mu Ci/mu g. (ERB)

1229 MEASUREMENT OF CARDIAC GLYCOSIDE CONCENTRATIONS IN SERUM OR PLASMA: TECHNICAL PROBLEMS AND CLINICAL IMPLICATIONS. Smith, T. W. (Massachusetts General Hospital, Boston). pp 25-37 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Digitalis intoxication occurs commonly in clinical practice and this led to a search for better techniques for the measurement of serum or plasma cardiac glycoside concentrations. Radioimmunoassay has been a useful approach to this problem. Both technical aspects and clinical use of cardiac glycoside radioimmunoassay are discussed. (auth)

1230 RENIN ACTIVITY ASSAY: ANGIOTENSIN I GENERATION AND RADIOIMMUNOASSAY. Sealey, J. E.; Laragh, J. H. (Columbia Univ., New York). pp 39-49 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

A method for measurement of plasma renin activity is described in which angiotensin I, generated during a 3 or 18 hour incubation period is quantitated by radioimmunoassay. The incubation step is carried out in undiluted plasma at the pH optimum (pH 5.7) with complete angiotensinase and converting enzyme inhibition by EDTA and DFP. Blank subtraction is eliminated by the generation of large amounts of angiotensin during incubation, which also increases the accuracy of the measurements. Recommendations for modification of commercially available kits include changes in the incubation step for generation of angiotensin I. A trouble-shooting section is included in which changes in the radioimmunoassay step are pointed out, which provide clues to possible errors and to sources of variability. (auth)

1231 DETECTION OF HEPATITIS B ANTIGEN (HBAg) BY RADIOIMMUNOASSAY. Briner, W. H. (Duke Univ. Medical Center, Durham, NC). pp 51-56 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Increased sensitivity in tests designed to detect the presence of HBAg has been noted in recent years. The availability of a reliable and safe solid-phase direct radioimmunoassay for the detection of this antigen has resulted in greatly increased protection for patients who must receive blood transfusions in the course of their clinical management. The use of this extremely sensitive test procedure has made possible the diagnosis of long-incubation hepatitis in other patients prior to the onset of clinically recognizable disease. The full impact of the results of this increased sensitivity on the delivery of health care is still to be demonstrated, although few will deny that an extremely important breakthrough has been attained. (auth)

1232 MEDICAL APPLICATION OF THE CARCINOEMBRYONIC ANTIGEN ASSAY. Lange, J. (Roche Clinical Labs., Inc., Raritan, NJ). pp 57-64 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

A radioimmunoassay was developed for the determination of carcinoembryonic antigen (CEA) in the serum of patients suspected of having neoplasms. It is a difficult assay requiring great care with extreme quality control. The test can be used in confirmation of a suspected carcinoma, for differentiation between malignant and benign growths, and between malignant diseases and inflammatory conditions. The test can also be used to monitor therapy. (ERB)

1233 RADIOIMMUNOASSAY OF GASTRIN. McGuigan, J. E. (Univ. of Florida, Gainesville). pp 65-74 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

By utilizing a variety of techniques it was possible to produce antibodies suitable for radioimmunoassay measurement of the polypeptide hormone gastrin. Various techniques were applied for satisfactory radioiodination of gastrin, as well as separation techniques to implement radioimmunoassay measurement of gastrin. The most important clinical application of radioimmunoassay measurement of gastrin at the present time is identification of increased gastrin levels in patients with the Zollinger-Ellison syndrome. These patients may be further identified and characterized by calcium infusion and secretin infusion studies. Gastrin exists in a variety of molecular species, each of which exhibits immunoreactivity with antibodies currently in use in radioimmunoassay of gastrin. It is anticipated that radioimmunoassay measurement of gastrin will contribute substanially to our understanding of the behavior of this polypeptide hormone in man in health and disease. (auth)

1234 COMPUTER APPLICATIONS IN RADIOIMMUNOASSAY. Hidalgo, J. U. (Tulane Univ., New Orleans); Irvin, M.; Spohrer, L.; Bloch, T.; Busby, H. D.; Trenchard, M.; McMullin, L. pp 75-82 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The automatic data processing used in the Nuclear Medicine Department of Touro Infirmary is described. The central processing unit is an IBM 360-40 equipped with remote terminals. The system is technologist/operator oriented, is quite efficient and has improved quality control. (ERB)

1235 CHEMICAL FOUNDATION OF TUMOR LOCALIZATION. Heindel, N. D. (Lehigh Univ., Bethlehem, PA). pp 83-92 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The biochemical basis for tumor and organ uptake of various radiopharmaceuticals is discussed. While there is no single underlying chemical foundation for anticipating tumor localization, several principal mechanisms do appear to operate. These include the labeled antibody approach, the abnormal permeability hypothesis, and the kinetic mechanism that relies on enhanced tumor growth rate to absorb, at an elevated rate, the components required for cell reproduction. (ERB)

1236 ROLE OF A RADIOPHARMACIST IN THE DEVELOPMENT OF A TUMOR-LOCALIZING RADIOPHARMACEUTICAL. Briner, W. H. (Duke Univ., Durham, NC). pp 93-98 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The development of a new radiopharmaceutical involves heavy responsibility relating to the safety of human lives. Although in past years the primary concern manifested by regulatory agencies was directed toward the radiation characteristics of these agents, more recent attention has been directed to the pharmaceutical quality of radioactive drugs. The technology of radiopharmaceutical design and formulation includes both aspects. Thus radiopharmacists have an exceedingly important role to play in this research and development area, for their training and experience in both the physical and biological sciences, their expertise in pharmaceutical formulation and quality control techniques, and their knowledge of laws and regulations that apply to all drugs can be invaluable. (auth)

1237 INSTRUMENTATION FACTORS IN VISUALIZATION OF TUMORS. Harris, C. C. (Duke Univ., Durham, NC). pp 99-119 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Tumor detection as a function of perception with a two-dimensional radionuclide image is considered. It is shown that visualization of tumors depends on tumor/nontumor contrast as perceived in the image. The actual count rate observed from a tumor/nontumor situation depends on activity ratios, tumor location, collimator properties, and radiation scattering. Statistical considerations of count density, display system data manipulation, and display medium characteristics are discussed. (MCG)

1238 DEVELOPMENT AND UTILIZATION OF TUMOR LOCALIZING RADIOPHARMACEUTICALS (^{111}In AND ^{67}Ga). Weinstein, M. B. (Univ. of Miami, FL). pp 121-159 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The mechanism whereby indium and gallium concentrate in tumors is currently unknown. Initial observations were serendipitous, but current investigations have demonstrated concentration of these trivalent cations in the lysosomal fraction of cells. Results of recent examinations of patients with ^{67}Ga and ^{111}In simultaneously are presented and discussed. Concern relative to concentration of gallium in nonneoplastic lesions as well as excessive gut concentrations led to the investigation of ^{111}In. Indium suffers from the same degree of nonspecificity as ^{67}Ga. (ERB)

1239 LABELED CHLOROQUINE ANALOG IN DIAGNOSIS OF OCULAR AND DERMAL MELANOMAS. Beierwaltes, W. H. (Univ. of Michigan, Ann Arbor). pp 161-170 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

On the basis of the melanin-specific properties of chloroquine, an ^{125}I-labeled chloroquine analog (NM-113) was synthesized for use in the diagnosis of ocular and dermal melanomas. The limitations and indications for the use of NM-113 in the diagnosis of dermal melanomas are summarized, and its efficiency in the diagnosis of ocular melanomas is discussed. The low probability of side effects (radiation effects) on the retina from a diagnostic dose of 2 m Ci (46 rads) is mentioned. (ERB)

1240 RADIOLABELED AMINO ACIDS, ANTIGENS, AND ORGANIC COMPOUNDS IN TUMOR LOCALIZATION. Spencer, R. P. (Yale Univ., New Haven). pp 171-178 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Following a brief summary of four techniques currently available for tumor localization, the author investigates the use of inorganic radiopharmaceuticals, labeled amino acids, and radiolabeled organic compounds. Among the inorganics currently under investigation is the compound cis-diaminedichloroplatinum labeled with either /sup 193m/Pt or /sup 195m/Pt. Current interest in labeled amino acids centers around the fact that reduced technetium can be bound to certain diamino acids as well as polyamino acids. Such observations suggest the design of peptides that both bind a short-lived radionuclide and have specificity for a particular tissue. The possibilities available through the use of labeled foreign antibodies are mentioned. There are two principal types of organic compounds suitable as labeled compounds for use in tumor localization: active-site-directed enzyme inhibitors such as aminopterin; and compounds that bind to tissue components such as iodoacetic acid which binds to sulfhydryl groups. (ERB)

1241 ADRENAL TUMOR LOCALIZATION WITH IODOCHOLESTEROL. Beierwaltes, W. H. (Univ. of Michigan, Ann Arbor). pp 179-192 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The efficiency of ^{131}I-19-iodocholesterol as an adrenal tumor localizing agent is demonstrated by the following points: its accuracy is comparable to venography; resolution is more than 1 cm;

it is routine procedure; it is completely noninvasive and nontraumatic; no hospitalization is required; and it provides valuable functional information. (ERB)

1242 PRESENT STATUS OF THE ^{32}P TEST IN OPHTHALMOLOGY. Carmichael, P. L. (Wills Eye Hospital, Philadelphia); Holst, G. C.; Federman, J. L.; Shields, J. A. pp 193-202 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

Studies agreed with Hagler and Jarrett that the ^{32}P test continues to be the most accurate test devised for the diagnosis of malignant melanoma. The one false negative test was one in which the probe could not be accurately placed because the lesion was pedunculated and adjacent to the optic disc. There were no false positive tests in this series. An attempt to correlate the percentage uptake with the cell type of the melanoma was unsuccessful. Perhaps further studies may elucidate what should be a possible connection between the metabolic activity of a given tumor and amount of radiophosphorus uptake within the lesion. The relative quantities and localizations of ^{32}P in normal choroid, retina, cornea, lens, tumor, and vitreous are being studied. A significant amount of ^{32}P may enter the vitreous cavity around the tumor. This knowledge should lead to a more precise understanding of the true basis for the clinical test as it is now performed. (ERB)

1243 CHARACTERISTIC RADIONUCLIDE APPEARANCE OF CERTAIN PEDIATRIC CENTRAL NERVOUS SYSTEM NEOPLASMS. Conway, J. J. (Children's Memorial Hospital, Chicago). pp 203-213 of New Techniques in Tumor Localization and Radioimmunoassay. Croll, M. N. (ed.). New York; John Wiley and Sons (1974).

From symposium on new techniques in tumor localization and radioimmunoassay; Philadelphia, Pennsylvania, USA (3 May 1973). See CONF-7305114-.

The results of 5 years experience in the localization of brain neoplasms in children are summarized. The radiopharmaceutical of choice was /sup 99m/Tc-labeled pertechnetate administered in a dosage of 100 mu Ci/lb. The appearance of the most common neoplasms of the central nervous system in childhood is characterized. (ERB)

1244 TERMS AND DEFINITIONS IN THE FIELD OF RADIOLOGICAL TECHNIQUE. Scintigraphy of Incorporated Radioisotopes. Draft. pp DIN 6814, Bl.10 of German Norms. Berlin, F. R. Germany; Beuth (Nov 1973). (In German).

Loose-leaf binding.

Definitions are given of the following terms and concepts: scintigraphy, scintigram, scanner, gamma camera, types of scintigrams, detection level and area, scanning rate and mode, line distance, step length, scanning period, recording level, imaging ratio; furthermore of terms from the field of measured value processing, such as basic pulse number and rate, pulse density, contrast amplification, subtraction, and suppression of a pulse rate. (GE)

1245 A SIMPLE LABORATORY EQUIPMENT FOR $^{14}CO_2$-LABELLING OF PLANTS. Heyland, K. U.; Solansky, S.; Aufhammer, W. (Bonn Univ. (F. R. Germany). Inst. fuer Pflanzenbau). Angew. Bot.; 48: No. 1/2, 63-75(Apr 1974). (In German).

To solve the problems arising when the distribution of assimilates within the plant is studied in multifactorial experiments, a simple and relatively inexpensive laboratory equipment was designed for labelling defined assimilation areas of cereal plants with $^{14}CO_2$. The equipment consists of several units (support structure, movable light bridge, three assimilation chambers, gas generator, CO_2 + $^{14}CO_2$ absorption columns, apparatus for counting) that are described separately. Each chamber can hold the assimilating areas of 18 individual plants. By using partly simultaneous experimental steps, the uptake of specified quantities of $^{14}CO_2$ by defined assimilation areas of a fair number of plants is made possible in a relatively short time. The technical specifications of the equipment were tested and found to satisfy the requirements. Finally, a test with plant material was carried out. The results are discussed. Considerable variability was observed, although the greatest care was taken to create uniform and reproducible conditions. The variations must be ascribed to individual differences in the material tested. This necessitates a statistical analysis of the results. An experimental design is, therefore, required, which allows the adequate statistical treatment of the data obtained from the laboratory equipment described here. (auth)

1246 DIFFERENCES IN THE NORMAL VALUES OF THE SURVIVAL OF RED BLOOD CELLS LABELED WITH ^{51}Cr. Lanaro, A. E.; Bosch, A.; Frias, Z. (Centro Nuclear de Puerto Rico, San Juan). Rev. Biol. Med. Nucl.; 1: No. 1, 1-4(1974).

A group of 20 normal subjects was studied for the purpose of determining the normal values of survival of red blood cells labelled with ^{51}Cr. The values obtained were 36.1 ± 3.5 days as an average with fluctuations from 28.5 to 42.0. These values were compared with literature data. (tr-auth)

1247 DEMONSTRATION OF REFLEX-BLEEDING IN FIREFLIES (COLEOPTERA) BY HELP OF RADIOACTIVE TRACERS. Kloft, W. J.; Lloyd, J. E.; Bhatkar, A. P. (Univ., Bonn). Experientia; 31: No. 4, 450-451(15 Apr 1975). (In German).

The very short time (5 to 9 min) between injection of radiophosphorous into the hemolymph of adult fireflies (Lampyridae) and outflow of radioactive droplets after irritation demonstrates with certainty that reflex-bleeding is involved. Labelling the secretions of dermal glands would require much more time (several h or even 1 day). (auth)

1248 QUICK AND SIMPLE RADIOIMMUNOLOGICAL DETERMINATION OF INSULIN. Esztergalyos, J. Magy. Radiol.; 27: No. 1, 54-58(Feb 1975). (In Hungarian).

A method has been worked out by the author, by means of which the radioimmunological determination of the insulin is performable instead of 24 hours in 3 hours. The modifications comprise the measurement of the reagents, the incubation temperature and the chemical reaction. On the basis of the comparison of the results with those obtained by the conventional methods it was found by the author that the modification of the method does not influence the accuracy of the results of the measurements, their reproducibility or specificity. (auth)

1249 CO_2: BREATH TEST. New Diagnostic Method in Diseases of the Small Intestine. Schjoensby, H. (Haukeland Sykehus, Bergen). Tidsskr. Norske Laegforen.; 95: No. 6, 370-373(28Feb 1975). (In Norwegian).

Bacterial deconjugation of bile acids was assessed by measuring $^{14}CO_2$ specific activity in breath samples at intervals after feeding ^{14}C-glyco-cholic acid. The specific activity of $^{14}CO_2$ was markedly increased in nine patients with ileal disease and three patients with the blind loop syndrome. The ^{14}C-glycocholic acid breath test is likely to be a simple and sensitive outpatient test for detecting altered bile acid metabolism in intestinal disease. (auth)

1250 PLASMA ALDOSTERONE BY RADIOIMMUNOASSAY, DETERMINATION IN NORMAL MAN AND IN PATIENTS ON MAINTENANCE HAEMODIALYSIS. Oelgaard, K. (Rigshospitalet, Copenhagen). Scand. J. Clin. Lab. Invest.; 35: No. 1, 31-39(Jan 1975).

The plasma aldosterone concentration was measured by a radioimmunoassay in which paper chromatography was used for separation of the steroids. The method had a low blank value (1.3 ± 2.8 pg/ml), and the sensitivity was 6 pg/ml. The variation coefficients for interassay and intraassay determinations were 13.0 and 9.4%, respectively. An accuracy study on fixed amounts of unlabelled aldosterone added to pool-plasma gave a linear correlation (slope = 0.9973). In a normal material, the mean plasma aldosterone concentration was found to be 120 pg/ml. In 26 patients on maintenance haemodialysis, the mean plasma aldosterone concentration was 68 pg/ml, in the group of anephric patients 36 pg/ml, and the nonnephrectomized group 91 pg/ml. There was a significant difference ($P < 0.01$) between the two groups as well as between the total group of patients on maintenance haemodialysis and the normal subjects. (auth)

1251 THYROID FUNCTION DURING ERYTHROSINE INGESTION IN DOSES ENCOUNTERED IN THERAPY WITH CONVENTIONAL ANTIBIOTICS. Bernstein, R.; Haugen, H. F.; Frey, H. (Aker Sykehus, Oslo). Scand. J. Clin. Lab. Invest.; 35: No. 1, 49-52(Jan 1975).

Six euthyroid patients without clinical or biochemical evidence of any renal or thyroid disorder received a diet of fixed composition. They were given no drugs. Urine was collected quantitatively throughout the whole investigation for determination of iodine and creatinine. After 5 days on diet they received 1.91 μmol of erythrosine, corresponding to approximately 7.88 μmol of iodine daily for 10 days. Thyroidal radioiodine studies were performed, levels of plasma inorganic iodine were calculated, and thyroxine, protein-bound iodine, and total iodine in serum were determined before and during erythrosine ingestion. A statistically significant increase in plasma inorganic iodine or in urinary iodine excretion was not found. The other test results of thyroid function remained virtually unchanged. Based on clinical aspects of thyroidal iodine metabolism it is concluded that at the most 7.8% of the iodine content of the ingested erythrosine could have supplemented the iodine space. (auth)

1252 RADIOACTIVE HAPTEN-BINDING ASSAY FOR MEASURING ANTIBODIES TO THE PENTAPEPTIDE DETERMINANT OF PEPTIDOGLYCAN. Heymer, B.; Bernstein, D.; Schleifer, K. H.; Krause, R. M. (Rockefeller Univ., New York). J. Immunol.; 114: No. 4, 1191-1196(Apr 1975).

A major portion of the humoral immune response to peptidoglycans is directed against the non-cross-linked pentapeptide side chains of these ubiquitous bacterial antigens. At present, no specific and sensitive assay for pentapeptide antibody determination is available. Therefore, a radioimmunoassay has been developed which employs the synthetic pentapeptide hapten L-Ala-gamma-D-Glu-L-Lys-D-Ala-D-Ala, labeled by the active ester method of Bolton and Hunter to high specific activities (6.74 to 18.18 muCi/mu g) with ^{125}I, and used as a reagent for measuring pentapeptide antibody. A-variant streptococcal antisera, known to contain pentapeptide antibodies as shown by quantitative precipitation, would bind more than 95 percent of the radiolabeled hapten in contrast to 2 to 3 percent by preimmune rabbit sera. Specificity of the binding reaction was demonstrated by inhibition experiments employing various synthetic oligopeptides related or unrelated to the pentapeptide in the radioimmunoassay. Binding curves established with serial dilutions of peptidoglycan antiserum were linear from 15 to 500 mug/ml of antibody permitting pentapeptide antibody measurement within this range. Comparative data on pentapeptide antibody determinations by quantitative precipitation and radioimmunoassay are given and the time course of the production of this antibody in 14 rabbits hyperimmunized with A-variant streptococcal vaccine is reported. (auth)

1253 RADIOLIGAND RECEPTOR ASSAY FOR URINARY AND SERUM hCG. Tomoda, Y.; Miwa, T.; Ishizuka, N. (Nagoya Univ., Japan). J. Clin. Endocrinol. Metab.; 40: No. 4, 644-651 (Apr 1975).

A radioligand receptor assay system for urinary hCG and serum hCG was developed, using 1100–2000 xg fractions of homogenates of pig testis. This method is specific for hCG and LH, and the limit of detection for hCG was 20 mIU, which could be significantly discriminated from zero at the 95 percent confidence level. A nonspecific inhibition reaction which exerts its influence on the assay system has been found in the urine and serum, and in performing assays for urinary and serum hCG, it was necessary to remove the inhibition reaction by diluting the urine more than eight fold or subject the serum to an extraction procedure. Since the hCG of normal pregnancy and trophoblastic neoplasia showed a dose response curve similar to that of the International Standard hCG, it became clear that these hCG could be assayed with this method. The potency ratio RI measured by RRA and RIA of urinary hCG and serum hCG was different from those of normal pregnancy and trophoblastic neoplasia. (auth)

1254 MEASUREMENT OF SERUM CLOGESTONE ACETATE (AY-11,440) BY A RADIORECEPTOR ASSAY: A PRACTICAL APPROACH TO THE QUANTITATIVE DETERMINATION OF SYNTHETIC PROGESTINS. Stern, M. D.; Givner, M. L. (Ayerst Research Labs., Montreal). J. Clin. Endocrinol. Metab.; 40: No. 4, 728-731(Apr 1975).

A novel method is described for the measurement of nanogram quantities of clogestone acetate (3beta, 17alpha-dihydroxy-6-chloropregna-4, 6-dien-20-one 3, 17-diacetate) in serum: clogestone acetate (CgAc) is converted to chlormadinone acetate in the presence of wheat germ lipase and hydroxysteroid dehydrogenase. The ketonic steroid formed is then incubated with rat uterine cytosol and ^{3}H-progesterone. The concentration of $_{3}CgAc$ is estimated from a standard curve derived by incubating cytosol with ^{3}H-progesterone and varying amounts of chlormadinone acetate. The statistically validated method has been used for the estimation of serum CgAc in humans and dogs given an oral dose of the steroid. The radioreceptor assay (RRA) has practical advantages over related techniques such as radioimmunoassay (RIA) especially with respect to the developmental work. This is the first time that a quantitative assay of a progestin by the tissue receptor approach has been described. (auth)

1255 RADIOIMMUNOASSAY FOR THE MEASUREMENT OF PYROGLUTAMYL-HISTIDYL-PROLINE, A PROPOSED THYROTROPIN RELEASING HORMONE METABOLITE. Visser, T. J.; Klootwijk, W.; Docter, R.; Hennemann, G. (Erasmus Univ., Rotterdam). J. Clin. Endocrinol. Metab.; 40: No. 4, 742-745 (Apr 1975).

A highly specific radioimmunoassay for the measurement of pGlu-His-Pro-OH (TRH-OH), a compound proposed to be a metabolite of pGlu-His-Pro-NH_2 (TRH) has been developed. Using this assay experiments have been performed to study the inactivation of TRH and TRH-OH by serum. The results show that TRH-OH is inactivated in a fashion resembling the inactivation of TRH as has been described by others. Support for the deamidation mechanism as the main pathway for TRH degradation could not be achieved. (auth)

1256 COLOR SCANNING IN TOPIC AND DIFFERENTIAL DIAGNOSIS OF RENAL TUMORS. Aivazyan, A. V. (Clinical Hospital No. 6, Moscow). Vop. Onkol.; 21: No. 3, 24-28(1975). (In Russian).

The results of careful investigation in 36 patients with tumors of the renal parenchyma, operated upon during the period since 1969 to 1972, are described. Extirpation of the kidney was performed in 34 patients, tentative biopsy in 2. In all patients along with the use of roentgenological, laboratory, and cytologic methods of investigation also radioisotope renography and color scanning have been accomplished. (auth)

1257 KURS OSNOV ATOMNOI TEKHNIKI V SEL'SKOM KHOZYAISTVE. (Course on the Principles of Atomic Techniques in Agriculture). Rachinskii, V. V. Moscow; Atomizdat (1974). 392p.

Theoretical and methodical principles in the use of atomic techniques in agriculture are presented. The general part of the course presents the principles of the physics of ionizing radiation, nuclear electronics, chemistry of isotopes, radiochemistry, radiation chemistry, radiobiology, and radiation safety. The special part of the course considers the use of isotopic and nuclear methods in agrochemical analysis, in soil research, and in biological studies. Particular attention is devoted to radiobiological methods of promoting the development of agriculture, and also to radioisotopic devices for automating industrial processes. (SJR)

1258 IN VIVO LABELLING OF NUCLEIC ACIDS DURING MICROSPOROGENESIS IN TOMATO. Singh, C. B. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Radiat. Bot.; 14: No. 4, 355-358(Dec 1974).

Methods are described for administering tritiated thymidine and orotic acid to microsporocytes of tomato at early meiotic prophase-I. Of five methods examined, bud inoculation proved to be the most effective for efficient entry and incorporation of precursors and convenience in handling a large population with least disturbance to the meiotic system. Application of this technique could be extended to other plant species having a similar growth habit and floral morphology. (auth)

1259 ADRENAL SCINTILLATION SCANNING WITH RADIOIODINATED CHOLESTEROL. Croisier, J. C.; Delorme, G.; Gest, J. (Centre de Lutte contre le Cancer Rene Huguenin, 92 – Saint Cloud (France)). Ann. Endocrinol. (Paris); 35: No. 3, 260-262(May 1974). (In French).

Static and dynamic hormonal determinations, apart from difficult step samplings, can only provide an overall functional assessment of the surrenals. The ideas of united or bilateral nature of destructive or proliferating lesions are provided by radiological investigations (pneumoretroperitoneum, arterial or venous opacification) with an accuracy that is not absolute. Hence, the exploration of the surrenals cannot but benefit from a scinti-scanning study that would provide the double functional and anatomic information of each of the two glands. A technique using 19-iodo-cholesterol-^{131}I as tracer was developed by Beurwaltes et al. However, this method is as yet inaccessible for routine work. To guard against drawbacks linked to the very nature of the tracer used (initial substrate of steroidogenesis whose extrasurrenalian pool is important, whose hepatic purification and intestinal excretion are partly reabsorbed and hindering) large doses of reactivity are delivered. Therefore an endeavor was made in the normal subject to reduce the diffuse residual activity by inhibiting the intestinal reabsorption of the cholesterol by the cholestyramine so as to obtain good images with reduced doses. (FR)

1260 HIGHLY AUTOMATIZED EVALUATION OF RADIOISOTOPIC RENAL FUNCTION STUDIES. Itti, R.; Floyrac, R.; Marchal, C.; David, B. (Centre Hospitalier Regional Bretonneau, 37 - Tours (France)). J. Biol. Med. Nucl.; 9: No. 36, 38-47(1974). (In French).

The standardization of the radioisotopic renal function study technique allows a highly automatized processing of the raw data collected from the scintillation camera, the cardiac single probe and the blood and urinary countings. The results that are ready for communication to the clinician consist of: plasmatic and excretion clearances of Hippuran; separate clearances for each kidney; clearances of hypaque; renography curves after plasmatic activity substraction and normalization by adjusting of the ascendent parts of the curves to the respective captation curves. So it is possible to assume quantitative comparisons between different patients or between successive examination for the same patient. (FR)

1261 DEVELOPMENT OF RADIOIMMUNOASSAY FOR PORCINE RELAXIN USING ^{125}I-LABELED POLYTYROSYL-RELAXIN. Sherwood, O. D.; Rosentreter, K. R.; Birkhimer, M. L.

(Univ. of Illinois, Urbana). Endocrinology; 96: No. 5, 1106-1113 (May 1975).

Tyrosine was incorporated into highly purified porcine relaxin employing the reagent N-carboxy-L-tyrosine anhydride. The resulting polytyrosyl-relaxin contained 1.67 mol of tyrosine per mol of relaxin, retained its original biological activity, and was readily radioiodinated to specific activities ranging from 80 to 100 muCi per mu g. High affinity antibodies applicable in final dilutions ranging from 1 : 50,000 to 1 : 200,000 were developed in rabbits against unconjugated highly purified porcine relaxin. A double antibody radioimmunoassay for porcine relaxin sufficiently sensitive to routinely measure from 32 to 1000 pg of pig relaxin was developed. Using this radioimmunoassay, peripheral serum concentrations of porcine relaxin were found to be less than 1 ng/ml during early pregnancy. Serum concentrations of porcine relaxin were high during late pregnancy. The mean concentration of porcine relaxin one day before parturition was 38 ng per ml. Within a day following parturition relaxin concentrations fell to a mean concentration of 2.1 ng per ml. (auth)

1262 REGIONAL MYOCARDIAL BLOOD FLOW MEASUREMENTS IN THE EVALUATION OF PATIENTS WITH CORONARY ARTERY DISEASE. Scheibel, R. L.; Moore, R.; Korbuly, D.; Ovitt, T. W.; Payne, J. T.; Tuna, N.; Amplatz, K. Radiology; 115: No. 2, 379-386(May 1975).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Myocardial imaging with ^{133}Xe and a gamma camera was employed to evaluate total and regional myocardial blood flow. The technique detected vasodilatation after injection of papaverine or diatrizoate. Contrast medium caused transient vasodilatation with return to baseline flow within five minutes. Myocardial tissue flow tended to decrease as coronary artery stenosis became more severe. There was overlap of flow measurements in patients with and without coronary artery disease. Coronary flow measurements made at rest are not considered to be an essential clinical tool. Greater diagnostic benefit is obtained from the scintigram which distinguishes between akinesia caused by ischemia and akinesia due to extensive scarring. (auth)

1263 COMBINED USE OF GATED CARDIAC BLOOD POOL SCANNING AND MYOCARDIAL IMAGING WITH POTASSIUM-43 IN THE EVALUATION OF PATIENTS WITH MYOCARDIAL INFARCTION. Rigo, P.; Strauss, H. W.; Pitt, B. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 115: No. 2, 387-391 (May 1975).

Fourteen patients with transmural myocardial infarction were studied by gated cardiac blood pool scanning (to determine regional ventricular function) and ^{43}K myocardial imaging (to determine the regional distribution of myocardial perfusion). An akinetic area on the gated scan and an area of decreased tracer concentration on the ^{43}K image were detected. The area of reduced ^{43}K concentration averaged 33.5 percent of the left ventricular circumference which correlated (r equals 0.74, p lt 0.01) with the area of infarction determined by the zone of akinesis, 34.2 percent of left ventricular circumference. The extent of akinesis and left ventricular ejection fraction were significantly different in those patients with left ventricular failure than in those without failure. (auth)

1264 INTRACRANIAL TUMORS: CORRELATION OF ANGIOGRAPHY WITH DYNAMIC RADIONUCLIDE STUDIES. Moore, J. S. Jr.; Kieffer, S. A.; Goldberg, M. E.; Loken, M. K. (Univ. of Minnesota, Minneapolis). Radiology; 115: No. 2, 393-398(May 1975).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

In a group of 100 supratentorial brain tumors, 23 percent demonstrated increased activity during the dynamic portion of the brain scan. Increased activity correlates best with the following angiographic characteristics: increased size of supplying vessels, and vascular supply simultaneously from both parenchymal and meningeal arteries. Increased activity has no correlation with the presence of early venous drainage, peritumoral edema, or degree of tumor vascularity and/or stain. (auth)

1265 RADIONUCLIDE ANGIOGRAPHY IN GRADED CAROTID STENOSIS. An Experimental Study with Angiographic Correlation. Weissman, B. N.; Holman, B. L.; Rosenbaum, A. E. (Harvard Medical School, Boston). Radiology; 115: No. 2, 399-402 (May 1975).

Radionuclide and contrast angiographies were performed in 10 dogs. In 6 dogs unilateral or bilateral (partial or total) carotid occlusions were produced by silk ligatures. Follow-up angiographies were carried out at intervals up to 6 months following surgery. Visual assessment of the radionuclide carotid angiogram was compared to quantitative analysis of the time-activity curves over these areas. Several parameters of these curves were reviewed. The ratio of the slopes was the most sensitive parameter of the assessment of carotid artery stenosis. The ratio of the slopes of the curves in normal dogs (mean 96 +- 5.2 S.D.) was significantly different from that in animals with stenosis greater than 80 percent (mean 67.3 +- 16.9 S.D.). (auth)

1266 ADVERSE REACTIONS (ASEPTIC MENINGITIS) FROM ^{111}In-DTPA CISTERNOGRAPHIC EXAMINATIONS. Jayabalan, V.; White, D.; Bank, M. (Hurley Hospital, Flint, MI). Radiology; 115: No. 2, 403-405(May 1975).

Cisternographic examinations have become a relatively common procedure in the evaluation of patients with suspected communicating hydrocephalus. Adverse reactions to radiopharmaceuticals are relatively uncommon, particularly with the commonly used agents such as ^{111}In-DTPA and ^{169}Yb-DTPA. Adverse reactions after lumbar intrathecal instillation of ^{111}In-DTPA in three patients are described. (auth)

1267 ^{99m}Tc-POLYPHOSPHATE BONE IMAGING IN LEGG-PERTHES DISEASE. Danigelis, J. A.; Fisher, R. L.; Ozonoff, M. B.; Sziklas, J. J. (Newington Children's Hospital, CT). Radiology; 115: No. 2, 407-413(May 1975).

/sup 99m/Tc-polyphosphate bone imaging was useful in distinguishing Legg-Perthes disease from other childhood hip disorders in 40 patients. In 33 Legg-Perthes patients, imaging provided earlier and more accurate information concerning the extent of the necrotic and revascularization process involving the hip than radiographs alone. This advantage could both facilitate treatment selection and provide a more objective baseline from which to judge treatment results. Preliminary experience also suggests that the technique may offer some insight into the pathogenesis of Legg-Perthes disease. (auth)

1268 TWO-COMPARTMENT CALCULATOR FOR THE DOG GLUCOSE POOL IN THE NONSTEADY STATE. Steele, R.; Rostami, H.; Altszuler, N. (Brookhaven National Lab., Upton, NY). Fed. Proc.; 33: No. 7, 1869-1876(Jul 1974).

From 57th annual meeting of the Federation of American Societies for Experimental Biology; Atlantic City, NJ (18 Apr 1973).

MATERIALS

Refer also to abstract 1834.

1269 (AD/A-001929) SURFACE ELECTRON STATES AND SURFACE STRUCTURAL STUDIES OF ELECTRONIC MATERIALS. Final Report, 1 September 1973–30 June 1974. James, W. J. (Missouri Univ., Rolla (USA)). Aug 1974. 11p. (AFOSR-TR-74-1790). NTIS $3.25.

Three research projects are discussed: (1) effort was concentrated on surface electromagnetic wave studies of metals, dielectrics, semiconductor (small particles), and ferroelectric and magnetic materials. Materials characterization, new physical phenomena, and new communications techniques were sought. (2) Ion implantation can transform crystalline silicon to amorphous silicon. This transformation is being studied by electron spin resonance measurements. Of principal interest has been the determination of the critical ion dose, the lowest dose at which the implanted layer becomes completely amorphous. (3) A study was made of the interface between carbon substrates and nickel films deposited on those substrates. The motivation for this work is the problem of producing graphite fiber-metal composites having high strengths at high temperature (>1000C) in oxidizing atmospheres. (GRA)

1270 (COO-1198-1155) ANNUAL PROGRESS REPORT. (Illinois Univ., Urbana (USA). Materials Research Lab.). Mar 1975. Contract AT(11-1)-1198. 82p. Dep. NTIS $7.25.

Activities in research programs are summarized on electronic structure of transition metal alloys, structure of superdense water and aqueous electrolytes, phase transformations in solid thin films, interaction of point defects with dislocations, high-temperature deformation of intermetallic compounds, deformation of metal composites, corrosion cracking, precipitation in refractory metal alloys, interstitial solid solutions, nuclear magnetic resonance, structure of matter under very high pressure, anharmonic effects in solids, electronic properties of solids, properties of noble gas crystals, physics of refractories, and radiation damage in solids. (JRD)

1271 (JPRS-63454) USSR AND EAST EUROPE SCIENTIFIC ABSTRACTS, MATERIALS SCIENCE, AND METALLURGY. No. 19. Translated from various journals. 99p. NTIS $4.75.

Abstracts are presented on metals and alloys, analysis and testing of metals and materials, metal corrosion, extraction, refining and forming, instrumentation, lubrication, mechanical and physical properties of metals, plastics, ceramic and refractory materials, rubber, textiles, welding practice, powder metallurgy, reactor technology and related fields. (GRA)

1272 (WANL-TME-313) PROGRAM FOR THE ALPHA PARTICLE BOMBARDMENT OF FUEL MATERIALS. Jacobs, D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Apr 1963. 2p. Dep. NTIS $4.00.

The following systems are to be exposed to alpha particles from the ANL cyclotron: UC, 20% UC–NbC, UC–80 and 50% ZrC, and W. (DLC)

1273 DECORATIVE ETCHING. Gray, R. J.; Crouse, R. S.; Leslie, B. C. (Oak Ridge National Lab., TN). pp 179-206 of Metallographic Specimen Preparation. McCall, J. L.; Mueller, W. M. (eds.). New York; Plenum Publishing Corp. ([nd]).

In contrast to chemical etching, decorative etching is defined as techniques for revealing the microstructure by adding something to the specimen surface that is controlled by or related to the substrate. This control or regulation is attributed to crystallographic orientation or chemical composition. It also includes examination of the as-polished surface with sensitive tint or plane polarized light to reveal colored microstructures. Techniques include alkali chloride crystallization, selective oxidation anodizing, vacuum deposition, plastic overlay, elemental printing, autoradiography, and magnetic etching. (28 fig, 33 references) (DLC)

Ceramics and Cermets

Refer also to abstracts 91, 166, 1330–1336, 1339, 1384, 1507, 1509, 1526, 2193, 2259, 2328, 2372, 2475, 2476, 2826, 2827, and 2829.

1274 (AD/A-001695) BEHAVIOR OF STABILIZED ZIRCONIA IN MOLTEN SODIUM SULFATE. Clarke, R. L.; Dapkunas, S. J. (Naval Ship Research and Development Center, Annapolis, Md. (USA)). Nov 1974. 20p. (NSRDC-4406). NTIS $3.25.

Samples of zirconia (ZrO_2) stabilized with various oxides including calcia (CaO), magnesia (MgO), and yttria (Y_2O_3) were exposed to molten sodium sulfate (Na_2SO_4) at 1650°F for periods up to 1000 hours to obtain an indication of the materials' resistance to sulfidation. Analysis by light and scanning electron microscopy, together with elemental x-ray fluorescence spectroscopy, indicated only slight attack of the zirconia manifested by surface roughening and the formation of crystalline "growths" thought to have a composition similar to that of zircon ($ZrSiO_4$). Thin, glass-like layers were formed on the surfaces of the MgO- and Y_2O_3-stabilized specimens tested for 1000 hours. Both the glassy layers and the crystalline "growths" contained trace amounts of sodium (Na), indicating that some reaction with the Na_2SO_4 had occurred. (GRA)

1275 (AD/A-001842) TRANSPORT, DIELECTRIC, AND SWITCHING PROPERTIES OF TRANSITION METAL OXIDES. Final Report, 1 April 1971–15 June 1974. Fuschillo, N.; Lalevic, B. (Rutgers–the State Univ., New Brunswick, N. J. (USA)). Sep 1974. 17p. (AFOSR-TR-74-1880). NTIS $3.25.

Transport mechanisms in amorphous films of transition metal oxides and polycrystalline films of CoO, CoO(Li), Nb_2O_5, and TiO_2 are of the Poole–Frenkel or Poole effect type. In NiO and NiO (Li) films, the transport mechanism is explained by the small-polaron conduction. Dielectric dispersion is due to the non-adiabatic hopping of charge carriers at low frequencies and adiabatic hopping at high frequencies. A novel type of switching is observed with switching, delay and recovery times of less than 3 ns in Nb–Nb_2O_5–Nb with sputtered Nb counterelectrodes. (GRA)

1276 (AD/A-002635) STRENGTH OF HARD ALLOYS. Kreymer, G. S. 25 Mar 1974. Translated from pp 201-215 of Metallurgiya, 1971. (FSTC-HT-23-1746-73). 62p. NTIS $4.25.

Strength and mechanical properties of two- and three-phase WC–TiC–Co and WC–TiC–TaC–Co alloys are discussed in relation to temperature, alloy composition, and alloy structure. The mechanism of breakdown under bending and compression and the effects of alloy structure on this process are described. Partial replacement of titanium carbide by tantalum carbide in three-phase WC–TiC–Co alloys tends to have a favorable effect on mechanical properties such as fatigue strength under bending and impact durability. (GRA)

1277 (AD/A-002649) SECONDARY ELECTRON EMISSION OF CERTAIN CERAMICS AND ANTIDYNATRON COATINGS. Malynin, Yu. G. Translated from Tr. Mosk. Energ. Inst.; No. 108, 85-87(1972). 5p. (FSTC-HT-23-594-74). NTIS $3.25.

The possibility of reducing the coefficient of secondary electron emission of aluminum oxide ceramics by applying coatings of boron nitride–vanadium oxide to their surfaces was investigated. Data are presented showing that the values of the coefficient for these ceramics, used in power taps of powerful superhigh frequency devices are dangerously high, with respect to increase in secondary electron discharge. Coatings with various proportions of boron nitride and V_2O_5 effectively reduce the coefficient of secondary electron emission. (GRA)

1278 (AD/A-002962) EFFECT OF SHOCK WAVES ON A SUBSTANCE. Phase and Chemical Changes in Niobium Pentoxide. Adadurov, G. A.; Breusov, O. N. 18 Nov 1974. Translated by M. Olaechea from pp 540-543 of Gorenie i Vzryv, Moscow, 1972. 10p. NTIS $3.25.

Results obtained in studies of changes in the crystalline structure of niobium pentoxide after being loaded by a shock wave up to pressures above 1.5 Mbar are presented. Shock compression was achieved primarily by the method of preserving cylindrical ampuls loaded by a sliding detonation of explosive charges. (GRA)

1279 (AD/A-003390) STUDY OF THE EFFECTS OF RADIATION ON THE ELECTRICAL AND OPTICAL PROPERTIES OF HgCdTe. Mallon, C. E.; Green, B. A.; Leadon, R. E.; Naber, J. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 30 Jun 1974. Contract F19628-72-C-0311. 87p. (INTEL-RT-8027-008). NTIS $4.75.

Results of experimental and theoretical investigation of the effects of irradiation (electron, neutron, and gamma) on the electrical and optical properties of the alloy semiconductor HgCdTe are discussed. The effects of radiation on the electrical and optical properties are of major interest in this program, since these data can then be used to predict radiation response of devices fabricated from HgCdTe. These results include measurements of the carrier concentration, Hall mobility, carrier lifetime, photoconductive spectral response, and optical transmission before irradiation as a function of irradiation fluence, and as a function of anneal temperature. Theoretical analysis

and models are presented to explain irradiation-produced changes. (GRA)

1280 (AED-CONF-74-495-001) EPITACTIC DEPOSITION OF SILICON CARBIDE BY REACTION OF SILICON TETRACHLORIDE WITH HEXANE. Muench, W. V.; Pfaffeneder, I. 1974. 6p. (In German). INIS.

From conference: basic principles of epitaxy; Erlangen, F. R. Germany (30 Sep 1974).

The conditions for SiC growth, which lead to certain poly types, in particular to 6 H-type, are discussed. Furthermore, dosing experiments with nitrogen and boron are reported. (GE)

1281 (AED-CONF-74-571-018) REPORT ON THE ONE-YEAR EXPERIENCE WITH THE PLUTONIUM FUEL PIN FABRICATION PLANT OF BELGONUCLEAIRE DESSEL. Leblanc, J. M. 1974. 8p. (In French). INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

The plant and fabrication process for plutonium fuel pins are described and important details such as capacity, quality control and safety problems are discussed. The fabrication deals with PuO_2 and PuO_2-UO_2 fuel (powder, pellets, and fuel rods). (GE)

1282 (AGARD-CP-156, pp 21-33) MECHANICAL METALLURGY OF DIRECTIONALLY SOLIDIFIED COMPOSITES: STRENGTHENING FUNDAMENTALS, TENSILE, CREEP, FATIGUE, AND TOUGHNESS PROPERTIES. Lawley, A. (Drexel Univ., Philadelphia). 1974.

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

A fundamental basis for the interpretation and prediction of the mechanical behavior of in-situ composites is developed by considering possible strengthening mechanisms and associated models. Experimental property data and structural observations are then discussed in light of these mechanisms. The general features of tensile, creep, fatigue, and impact loading are characterized and behavior interpreted from the viewpoint of structure. Where possible, observed and predicted response of in-situ composites are compared, as is the behavior of comparable synthetic composites. The various structure-mechanical property correlations allow for a rationalization of the major advantages and disadvantages of in-situ composites vis a vis synthetic composites and other advanced structural materials. (auth)

1283 (AGARD-CP-156, pp 93-111) DIRECTIONALLY SOLIDIFIED COMPOSITE SYSTEMS UNDER EVALUATION. Ashbrook, R. L. (Lewis Research Center, Cleveland). 1974.

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

The directionally solidified eutectic in-situ composites being evaluated for use as turbine materials range from ductile-ductile systems, where both matrix and reinforcement are ductile, to brittle-brittle systems, where both phases are brittle. The alloys most likely to be used in gas turbine engines in the near term are the lamellar ductile-semi ductile alloys gamma prime-delta, Ni_3Al-Ni_3Nb and gamma/gamma prime-delta Ni, Cr, Nb, Al/Ni_3Al-Ni_3Nb and the fibrous ductile-brittle alloys M-MC CoTaC or NiTaC and M-M_7C_3(Co, Cr, Al)-(Cr, Co)$_7$C3. Gamma prime strengthened NiTaC alloys and a (Co, Cr, Al)-(Co, Cr)$_7$C3 have greater tensile strength than the strongest superalloys at temperatures up to about 600°C. The gamma prime-delta and gamma/gamma prime-delta alloys in the Ni, Al, Nb(Cr) systems have greater tensile strength than the superalloys at temperatures greater than 800°C. At low stresses fibrous carbide reinforced eutectic alloys have longer lives at high temperatures than the strongest superalloys. Lamellar delta, Ni_3Nb reinforced eutectic alloys have longer lives at high temperatures than the strongest superalloys at all stresses. The experience currently being gained in designing with the brittle ceramics SiC and Si_3N_4 may eventually be applied to ceramic matrix eutectic in-situ composites. However, the refractory metal fiber reinforced brittle-ductile systems may find acceptance as turbine materials before the ceramic-ceramic brittle-brittle systems. (auth)

1284 (AGARD-CP-156, pp 117-124) THERMAL STABILITY OF DIRECTIONALLY-SOLIDIFIED COMPOSITES. Gell, M. (Pratt and Whitney Aircraft, East Hartford, CT). 1974.

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

Microstructural and mechanical property stability under static and cyclic temperature exposure are two important requirements for turbine airfoil materials in advanced gas turbine engines. High-temperature directionally-solidified eutectics, such as TaC-carbide reinforced-nickel and cobalt alloys, and Ni_3Nb (δ) reinforced-nickel alloys may be exposed to greater than 0.9 of their absolute melting temperature without the reinforcement phase experiencing degradation. Under thermal cycling conditions, significant microstructural instability and mechanical property degradation has been observed in a number of TaC-reinforced alloys, while the delta-reinforced alloys have exhibited greater stability. The physical and chemical properties of the eutectic promoting microstructural instability and the testing variables defining the severity of the thermal cycle are discussed. (auth)

1285 (AGARD-CP-156, pp 141-154) FUTURE PROSPECTS OF REFRACTORY COMPOUNDS PREPARED BY UNIDIRECTIONAL SOLIDIFICATION. Bibring, H. (ONERA, Chatillon, France). 1974. (In French).

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

An evaluation of the possibilities offered by the utilization of more fully developed high temperature directionally solidified (DS) composites as aircraft blade materials is given. Properties of lamellar intermetallic eutectics of the $\gamma'-\delta$ type (Ni_3Al-Ni_3Nb) recently broadened to the quaternary composition systems $\gamma/\gamma'-\delta$ with Cr additions, and the COTAC family i.e. multicomponent fiber composites incorporating superalloy matrices reinforced by in-situ aligned monocarbide whiskers are reviewed. When compared with the best superalloys, both these families show an important gain in operational temperatures. Weak points, particularly noticeable in some of these new materials, such as lack of ductility, poor corrosion resistance, and thermal cycling problems should be improved. Progress already achieved open the way to a reliable and safe utilization of DS composites as engineering materials. (auth)

1286 (JEN-291) GRINDING OF URANIUM DIOXIDE FROM FLUIDIZED BEDS. Alonso Folgueras, J. A. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 16p. (In Spanish). Dep. NTIS (US Sales Only) $4.25.

Vibratory grinding of UO_2 obtained from fluidized beds is described. The grinding time has been correlated with surface area, stoichiometry, granulometry, and product contamination. The efficiency losses in the grinding of moist UO_2 are outlined. Results of a brief study of the granulate obtained from the ground UO_2 and the resulting green pellets are included. (auth)

1287 (WANL-TME-1351) GROUP IVB AND VB METAL CARBIDE-CARBON EUTECTIC TEMPERATURES. Adelsberg, L. M.; Cadoff, L. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 15p. Dep. NTIS $4.00.

Two techniques were used to establish the eutectic isotherms: temperature excursion, and isothermal anneal-metallography. Results are: TiC-C, 2760 ± 50°C; ZrC-C, 2890 ± 50°C; HfC-C, 3150 ± 50°C; VC-C, 2670 ± 50°C; NbC-C, 3220 ± 50°C; and TaC-C, 3450 ± 50°C. They are compared with previous values. (DLC)

1288 (WANL-TME-1369) DEVELOPMENT OF A CbC-ZrC MATERIAL FOR USE AS A HOT HARDNESS INDENTER. Godshall, J. L.; Berger, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 82p. Dep. NTIS $7.25.

A pseudo-binary niobium carbide-zirconium carbide (NbC-ZrC) of 96% theoretical density was prepared by hot pressing of powdered carbides for use as a hot hardness indenter to measure the hardness of refractory alloys at elevated temperatures. Attempts to further densify the carbide by high energy rate (Dynapak) extrusion, arc-melting, high-temperature sintering in graphite, and liquid-phase sintering in vacuum were generally unsuccessful. The carbide, prepared without any contaminating binder, showed excellent hardness values at 1315°C (2400°F), good compatibility with Nb and Ta base alloys, and was capable of being ground to a fine point Vickers configuration. However, when the NbC-ZrC carbide was used as the indenter at 1315°C (2400°F), the fine point flattened during the indentation. (auth)

1289 (WANL-TNR-205) DIFFUSION OF CARBON IN TANTALUM CARBIDES. Brizes, W. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1967. 12p. Dep. NTIS $4.00.

Experimental results are presented showing that the diffusivity of C in TaC is not constant across the stoichiometric range of TaC. Equations describing the concentration of C as function of

position in a TaC layer are used with data on rate constants and boundary conditions to plot a profile of C concentration as function of distance from surface. (JRD)

1290 CONCENTRATION DEPENDENCE OF ABRASIVE PROPERTIES OF MOLTEN NIOBIUM CARBIDE. Samsonov, G. V.; Stepanchuk, A. N.; Pritulyak, A. S.; Shlyuko, V. Ya.; Adamovskii, A. A. (Kiev Polytechnical Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 90-93(Jan 1975). (In Russian).

Mechanical and abrasive properties (microhardness, microbrittleness, microsection grain crushing strength, abrasive ability proper) of carbide phases were studied in niobium within the homogeneity region. The effect of the carbon content in the carbide phases on their abrasive ability is determined. Recommendations are given for application of the carbide phases of niobium in the composition of abrasive tools. (auth)

1291 CERTAIN PROPERTIES OF CARBIDE ALLOYS OF ZIRCONIUM AND NIOBIUM IN REGIONS OF THEIR HOMOGENEITY. Samsonov, G. V.; Naumenko, V. Ya.; Ryabokon, L. P.; Verkhoturov, A. D. (Inst. of Problems in Mathematics, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 54-58(Jan 1975). (In Russian).

Homogeneous carbide alloys (C/Me = 0.82 – 0.98) were obtained from zirconium and niobium powders and acetylene black by means of synthesis in vacuum. On the basis of chemical and X-ray analyses it is shown that carbide alloys of zirconium and niobium are solid solutions with FCC-lattice of the NaCl type. Concentration dependences of electroemission resistance, microhardness, resistivity, and coefficients of thermal expansion of carbide alloys $Zr_xNb_{1-x}C_y$ were studied in the regions of their homogeneity. With equimolar composition, the carbide alloys revealed an extremal change in their electrophysical properties within the homogeneity region. On the basis of such character of the concentration changes in the properties, a conclusion is made on the predominant role of $Me^{IV} - Me^{V}$-interactions in the total binding energy of carbide alloys of zirconium and niobium in the regions of their homogeneity. (auth)

1292 CREEP FRACTURE PROCESSES IN URANIUM DIOXIDE. Reynolds, G. L.; Burton, B.; Speight, M. V. (Berkeley Nuclear Labs., Eng.). Acta Met.; 23: No. 5, 573-577(May 1975).

Creep fracture processes were studied in UO_2. At high rates of strain, fracture occurs by the propagation of the triple point cracks which extend large distances along grain boundaries. At lower rates of strain the fracture mode involves the growth of rounded cavities on boundaries parallel to the compressive stress axis. The growth of these cavities is attributed to a vacancy condensation mechanism driven by internally generated tensile components of stress. The magnitude of this tensile stress is calculated and the conditions for growth are estimated. The nonstoichiometric and large grained material is more susceptible to creep damage. This increased susceptibility is attributed to the increased magnitude in grain boundary sliding offsets in the large grained material and to increased ease of sliding in the non-stoichiometric material. (auth)

1293 ELECTRONIC CONDUCTIVITY IN NONSTOICHIOMETRIC CERIUM DIOXIDE. Blumenthal, R. N.; Sharma, R. K. (Marquette Univ., Milwaukee). J. Solid State Chem.; 13: No. 4, 360-364(Apr 1975).

The electrical conductivity of sintered specimens of nonstoichiometric CeO/sub 2-x/ was measured as a function of temperature (750 to 1500°C) and oxygen pressure (1 to 10^{-22} atm). The isothermal compositional dependence of the electrical conductivity of CeO/sub 2-x/ was determined by combining recently obtained thermodynamic data, x equals x(Po_2, T), with the conductivity data. The compositional and temperature dependence of the electrical conductivity may be represented by the expression sigma equals 410[x]e/sup -(0.158 + x)/kT/ (ohm cm)$^{-1}$ over the temperature range 750 to 1500°C and from x equals 0.001 to x equals 0.1. This expression was rationalized in terms of the following simple relations for the electron carrier concentration, n/sub Ce'/sub Ce// equals $8x/a_0^3$, where n/sub Ce'/sub Ce// is the number of Ce'/sub Ce/ per cm^3 and a_0 is the lattice parameter, and for the electron mobility, mu equals $5.2(10^{-5})$e/sup -(0.158 + x)/kT/ (cm^2/V sec). (auth)

1294 GRAIN-BOUNDARY DIFFUSION OF U IN PURE AND DOPED URANIUM CARBIDES WITH DIFFERENT C/U RATIOS. Routbort, J. L.; Matzke, H. (EURATOM, Karlsruhe, Ger.). J. Amer. Ceram. Soc.; 58: No. 3-4, 81-84(1975).

The grain-boundary diffusivity of U in UC was measured between 1200° and 2200°C in pure carbides with a wide range of C/U ratios (0.93 to 2.00) and in material doped with up to 2.4 wt% W, V, or Ta. Grain-boundary diffusion is ≈ 10^3 to 10^5 times faster than volume diffusion, and, for $UC_{1.0}$, has an activation enthalpy of 75.9 ± 9.1 kcal/mol, ≈ 55% of that for volume diffusion. In the monocarbide region, grain-boundary mobility increases as the C/U ratio decreases and is impeded by the addition of impurities. (auth)

1295 U–B SYSTEM. Mar, R. W. (Sandia Labs., Livermore, CA). J. Amer. Ceram. Soc.; 58: No. 3-4, 145(1975).

The features of the U–B phase diagram established in the present work are: (1) a proposed melting temperature for UB_{12} of 2145°C; (2) a eutectic between UB_2 and UB_4 at approximately 75 at. percent B and greater than 2200°C; (3) the liquidus and eutectic temperatures in the 92 to 100 at. percent B portion of the system, and (4) slight variation of the lattice constant of UB_{12} with composition; UB_4 showed no variation. (auth)

1296 CREEP BEHAVIOR OF URANIUM CARBIDE-BASED ALLOYS. Seltzer, M. S.; Wright, T. R.; Moak, D. P. (Battelle Columbus Labs., OH). J. Amer. Ceram. Soc.; 58: No. 3-4, 138-142(1975).

Compression creep tests were performed on fully dense specimens of $UC_{1.01}$, $UC_{1.05}$, $UC_{1.01}$ + 4 wt percent W, and $U_{0.9}Zr_{0.1}C_{1.01}$ + 4 wt percent W. Steady-state creep rates were measured from 1400° to 1800°C in a vacuum of 1.33×10^{-3} N/m^2 (1×10^{-5} torr) at stresses of 4.55 to 69.0 MN/m^2 (660 to 10,000 psi). The data for $UC_{1.01}$ could best be fit by an expression of the form epsilon equals 1773 $sigma^{6.024}$ exp (106.5/RT), where epsilon is the steady-state creep rate (h^{-1}), sigma is the applied stress (MN/m^2), and the creep activation energy is given in kcal/mol. The stress dependence for creep of $UC_{1.05}$ decreased with decreasing temperature because of second-phase precipitation; therefore, a unique creep activation energy could not be established for this U/C ratio. At all temperatures, the creep strength of $UC_{1.05}$ exceeded that of $UC_{1.01}$. For example, at 1700°C steady-state creep rates for $UC_{1.05}$ are approximately 1/4 those for $UC_{1.01}$, but at 1400°C the creep rates are approximately 3 orders of magnitude less. At 1700°C, creep rates for UC alloys are approximately 4 orders of magnitude lower than those for unalloyed $UC_{1.01}$. (auth)

1297 HIGH-TEMPERATURE CREEP OF Y_2O_3–STABILIZED ZrO_2. Seltzer, M. S. (Battelle Columbus Labs., OH); Talty, P. K. J. Amer. Ceram. Soc.; 58: No. 3-4, 124-130(1975).

The compression creep behavior of Y_2O_3-stabilized ZrO_2 (YSZ) was studied at temperatures to 2000°C. The function of Y_2O_3 content and grain size was tested in specimens with various impurity concentrations and porosity distributions. For relatively fine-grained specimens, creep rates increased with the 1.5 power of the applied stress at low stresses and with the third power at high stresses. The results for coarse-grained specimens, in general, fit the cube dependence. The 1.5 power can be reduced to a linear dependence by correcting for an apparent threshold stress which decreases with increasing temperature. Creep activation energies for YSZ are 128 +– 10 kcal/mol, independent of Y_2O_3 content, impurity level, grain size, and porosity distribution. In addition, over a broad range of temperatures and stresses, the absolute values of the steady-state creep rates are influenced only by grain size and O_2 partial pressure. (auth)

1298 CLUSTER MODEL OF THE SOLID SOLUTIONS ZrN–NbC. Gusev, A. I.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1330-1331(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1542-1544(Aug 1974).

The cluster model was used to describe the concentration dependences of the lattice parameters of the disordered solid solutions $(ZrN)_y(NbC)_{1-y}$ with the NaCl structure. The slight defect content of the metal sublattices of the solid solutions is wholly due to the defect content of the metal sublattice of $Zr_\gamma N$. The matrix is expanded into the matrices of the cluster components. For the lattice parameters, calculation and experiment are in good agreement. (DLC)

1299 EFFECT OF ADMIXTURES OF ZrO_2 ON THE SINTERING AND CERTAIN PROPERTIES OF YTTRIUM OXIDE CERAMIC. Borovkova, L. B.; Lukin, E. S.; Bad'ina, L. L.; Poluboyarinov, D. N. (Moscow Chemical-Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1282-1285 (Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1488-1492(Aug 1974).

An investigation was made of the effect of up to 10 mole % ZrO_2 on sintering of pure Y_2O_3. Forming solid solutions with Y_2O_3, the added ZrO_2 greatly intensifies sintering in vacuum, and transparent materials with a nearly theoretical density can be obtained. The optimum amount of added ZrO_2 is 5 to 10 mole %. Roasting in a flame furnace does not result in complete sintering. Except for the deformation temperature under a load of 2 kg/cm^2,

and the creep rate, the properties of ceramic with added ZrO_2 are similar to those of Y_2O_3 ceramic itself. (auth)

1300 POLYMORPHIC TRANSITIONS OF RARE EARTH OXIDES AT HIGH TEMPERATURES. Lopato, L. M.; Shevchenko, A. V.; Kushchevskii, A. E.; Tresvyatskii, S. G. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1276-1281(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1481-1487(Aug 1974).

An investigation was made of phase transitions of rare earth oxides (above 1800°C) and the effects of oxides of Mg, Ca, Sr, and Ba on these transitions. In addition to the known forms (C and H), oxides of rare earths of the yttrium subgroup may exist in A and B polymorphic forms, and oxides of Tb, Dy, and Y may also exist in the X form; this is due to basic principles of the structure of phase diagrams of the systems Ln_2O_3–MO (Ln is a rare earth, M is Ca or Sr). The data were used to construct diagrams of phase transitions of pure rare earth oxides and of the latter with 10 mole % of added SrO. (auth)

1301 PHASE DIAGRAMS AND STRUCTURE OF ALLOYS OF QUASI-BINARY SYSTEMS Cr–ZrB_2 AND Cr–HfB_2. Shurin, A. K.; Panarin, V. E. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 1, 86-90(Jan 1975). (In Ukrainian).

Diagrams of phase equilibria were studied for quasi-binary systems Cr–ZrB_2 and Cr–HfB_2. Compositions of the eutectics and their melting temperatures are as follows: for Cr–ZrB_2 9.7 mol. (19 weight) % ZrB_2, 1550°C (±10°C); for Cr–HfB_2 9.6 mol. (29 weight) % HfB_2, 1610°C, (±10). Limiting solubilities of diborides in chromium are 0.3 mol. (0.7 weight) % ZrB_2 and 0.1 mol. (0.4 weight) % HfB_2. (auth)

1302 NEW TEST METHODS OF CERAMIC MATERIALS. Pabst, R. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). Z. Werkstofftech.; 6: No. 1, 17-29(Jan 1975). (In German).

The conventional tests of ceramic materials produce strength data which depend on specimen size and testing procedures. This is due to the particular brittle defect structure of these materials. To get material constants one may use statistic relations and data based on fracture mechanics test methods or on energy concepts. The different methods obtaining strength data characterizing the brittle structure are presented with a critical examination of its validity. The trend in the special field is emphasized. (auth)

1303 REGION OF EXISTENCE OF FLUORITE-LIKE SOLID SOLUTIONS IN THE SYSTEM HfO_2–MgO, AND THEIR PHYSICO-CHEMICAL PROPERTIES. Kuznetsov, A. K.; Tikhonov, P. A.; Kravchinskaya, M. V. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1290-1293 (Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1498-1501(Aug 1974).

The region of existence of fluorite-like solid solutions in the system HfO_2–MgO were established. The eutectoid point corresponds to 1500°C and 18 mole % MgO. The unit cell constants of the fluorite-like solid solutions and the variation of their resistivity with the composition were determined. The thermal expansion of these solid solutions before, during, and after decomposition were also investigated. (auth)

1304 EFFECT OF THERMAL CYCLING ON THE SUBSEQUENT OXIDATION BEHAVIOR OF AN ALIGNED Co-BASED TaC EUTECTIC ALLOY. Smeggil, J. G. (General Electric Co., Schenectady, NY). Oxidation Metals; 9: No. 2, 137-151(Apr 1975).

To examine the extent of any synergism between thermal cycling and oxidizing atmospheres, the oxidation behavior at 800 and 1000°C of the aligned eutectic alloy TaC–Co50B–3W (52.5 wt percent Co, 9.5 percent Ni, 15.7 percent Cr, 3 percent W, 12 percent Ta, 0.77 percent C) was examined in both the as-solidified state and after exposure to thermal cycling effects. Results indicate that thermal cycling strongly influences the oxidation behavior of this alloy. (auth)

1305 INTERSTITIAL ORDER AND EMBRITTLEMENT IN Ta–C ALLOYS. Rao, P. (General Electric Co., Schenectady, NY); Thomas, G. Acta Met.; 23: No. 3, 309-319(Mar 1975).

The effects of carbon on the structure and mechanical properties of tantalum at 77, 196, and 300°K were investigated. The alloys contained 0.76, 1.27, 1.53, and 2.05 at. percent C. Interstitial ordering was observed in all alloys with the formation and growth of aligned particles in (110) causing tweed contrast in electron micrographs. Analyses of electron diffraction patterns indicated that the fully developed single phase structure which is attained in Ta 1.53 and 2 at. percent C corresponds to a tetragonal or orthorhombic ordered lattice of composition $Ta_{64}C$ or $Ta_{32}C$. A model to explain these structures based on carbon fluctuations on specific [110] Ta planes is suggested. The alloys become completely brittle and cleave along [110] when the ordered structure is fully developed, i.e., when the carbon content is 1.53 at. percent or more. It is suggested that this embrittlement results from the severe elastic strains which arise due to ordering such that the restrictions on the elastic compliances can no longer be maintained. (auth)

1306 COMPATIBILITY OF Si_3N_4 AND $Si_3N_4 + Al_2O_3$ WITH LIQUID Na AND Li. Singh, R. N.; Tuohig, W. D. (Argonne National Lab., IL). J. Amer. Ceram. Soc.; 58: No. 1-2, 70-71(1975).

Tests for compatibility with Na were performed at 550°C in a closed type-316 stainless-steel capsule under Ar cover gas. Similar tests for Li were conducted at 400°C in a closed type-304 stainless-steel crucible under He. The tests were performed on 2 hot-pressed Si_3N_4 materials and on the hot-pressed 50 percent Si_3N_4 + 50 percent Al_2O_3 material. No appreciable weight change was noted in the samples exposed to Na and Li. X-ray diffraction traces obtained before and after the test were identical, and no reaction products were detected. The samples exposed to liquid Na showed evidence of attack at the grain boundaries. This attack may result from the presence of an impurity-rich phase formed at the boundaries during fabrication. After exposure to liquid Li, all samples exhibited an extensive crack network. To establish the kinetics of the cracking phenomenon, Li-compatibility tests were performed for 1 and 10 h at 400°C. The post-test appearance of the 10-h specimens was indistinguishable from that of the 300-h specimens. Material exposed for 1 h showed extensive cracking but retained its integrity to a slightly greater extent than that exposed for 10 h. Crack propagation is thus extremely rapid at relatively low temperatures; a mechanism similar to liquid-metal embrittlement may be responsible. (auth)

1307 CONCRETE: THE MATURITY OF A REACTOR MATERIAL. Huber, G. Trans. Amer. Nucl. Soc.; 20: 96-99(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1308 THE CONDUCTIVITY OF CERMETS AND OTHER MULTIPHASE MATERIALS. Comparison Between Experimental and Calculated Electrical Resistivities. Ondracek, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Z. Werkstofftech.; 5: No. 8, 416-428(Dec 1974). (In German).

"Stereometric functions of field properties," pointed out in previous work, are summarized here revealing the relation between the properties of multiphase materials and the concentration, shape, orientation and properties of their constituent phases. These equations are used now for calculating the electrical resistivity of cermets. Experimental values of about fifty various cermet combinations are compared with theoretical curves. The theoretically predicted dependence of the electrical resistivity on concentration, shape, orientation and temperature is clearly confirmed. Consequently the field properties of multiphase materials can be calculated from their stereometric microstructure data and field properties of their constituent phases. This helps in all cases, where, under certain conditions very low accuracy is to be expected from direct measurements, or when the microstructure can be more easily determined. Furthermore these equations show the direction in which the microstructure should be improved to achieve optimal properties (tailor made materials). Finally, these equations provide a means to avoid cumbersome data collections on multiphase materials, once the properties of the phases are well known. (GE)

1309 INTERACTION OF TITANIUM AND NIOBIUM CARBIDES WITH THEIR SCALE IN VACUUM. Lavrenko, V. O.; Chuprina, V. G.; Pomytkin, A. P.; Glebov, L. A. (Inst. of Problems in Material Sciences, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 3, 266-270(Mar 1975). (In Ukrainian).

The behavior of oxidized and non-oxidized titanium and niobium carbides at temperatures of 1000 to 1100°C was studied by means of the vacuum microweight and layer-by-layer x-ray diffraction methods. The character of solid-phase interaction in the carbide-scale is established. (auth)

1310 PREPARATION OF SMALL-PORE BAKED PARTS FROM ZIRCONIUM DIBORIDE. Kiparisov, S. S.; Libenson, G. A.; Pankevich, A. P. Tsvetn. Metal.; No. 1, 66-67(Jan 1975). (In Russian).

An activated sintering method was used for studying the conditions for making parts. The method of activated sintering is based on evaporation of Fe and Cr impurities at high temperatures. The properties of baked materials are presented. (tr-auth)

1311 PYROLYTIC ALLOYS OF CARBON WITH ZIRCONIUM DIBORIDE. Dergunova, V. S.; Emyashev, A. V.; Martynov, S. Z. Tsvetn. Metal.; No. 1, 65-66(Jan 1975). (In Russian).

The effect of the basic parameters of gas-phase precipitation on the composition of pyrolytic alloys was studied. Some of the properties of the Zr B_2–C system were studied. Examples are given of the use of these alloys as protective coverings on graphite parts. (tr-auth)

1312 STUDY OF THE Dy–O–S SYSTEM IN THE REGION OF HOMOGENEITY OF DYSPROSIUM OXYSULFIDE. Grizik, A. A.; Eliseev, A. A.; Borodulenko, G. P.; Strel'tsova, Yu. F. Zh. Neorg. Khim.; 20: No. 1, 228-231(Jan 1975). (In Russian).

The boundaries of the region of homogeneity of Dy_2O_2S, connected with the formation of a substitution solid solution, were determined. The possibility of synthesizing samples of Dy_2O_2S, sharply differing from each other in lattice parameters and crystallochemical properties, was noted. (tr-auth)

1313 STRUCTURE OF CO-SPUTTERED TUNGSTEN–ALUMINUM OXIDE GRANULAR FILMS. Pinch, H. L. (RCA Labs., Princeton, NJ). J. Vac. Sci. Technol.; 12: No. 1, 60-62(1975).

Tungsten–aluminum oxide granular films with metal volume fraction, x, varying from 0.9 to 0.15 were prepared by an rf sputtering technique in which the entire compositional range was simultaneously deposited. At the metal-rich end the tungsten particles are mainly in the normal bcc form (alpha-W). As x decreases, the amount of tungsten in the beta phase (A-15 structure) increases. At x approximately 0.3 the tungsten is all beta-W. In the as-prepared films the particle size, as determined by x-ray line broadening, varies from approximately 65 A to approximately 25 A as x varies from 0.9 to 0.15. Annealing the films results in particle growth and an increase in the amount of alpha phase. The beta phase persists in these granular films to much higher temperatures than reported elsewhere. It is proposed that the metastable beta-W phase is stabilized by the very small crystallite size. (auth)

1314 SYNTHESIS OF ALLOY CARBIDES BY THE ACTIVATED REACTIVE EVAPORATION PROCESS. Nimmagadda, R., Bunshah, R. F. (Univ. of California, Los Angeles). J. Vac. Sci. Technol.; 12: No. 1, 585-587(1975).

Several of the carbides of the group IV, V, VI elements exhibit complete solid solubility in each other. Specific compositions of the alloy carbides exhibit melting point maxima. This investigation was concerned with the deposition of alloy carbides using the activated reactive evaporation process. [R. F. Bunshah and A. C. Raghuram, J. Vac. Sci. Technol. 9, 1385 (1972)]. A Ti–6Al–4V alloy rod was evaporated from an electron-beam source in the presence of a partial pressure of C_2H_2 with all the vapor species being activated or partially ionized using the A.R.E. process. The deposits were characterized by x-ray diffraction and electron microprobe analysis. It was established that an alloy carbide deposit corresponding to a TiC–VC solid solution, with possibly Al present in the microstructure, was produced. (auth)

1315 CHARACTERIZATION OF TRANSPARENT CONDUCTIVE THIN FILMS OF INDIUM OXIDE. Molzen, W. W. (IBM Watson Research Center, Yorktown Heights, NY). J. Vac. Sci. Technol.; 12: No. 1, 99-102(1975).

A metal alloy target of indium doped with about 5 percent by weight tin was rf sputtered in 100 percent oxygen onto quartz substrates. These films of indium–tin oxide were then annealed at temperatures up to 600°C in an argon-flow system. Their optical and electrical properties were examined as a function of annealing temperature. Optimum film properties include a sheet resistance of 2–3 OMEGA/Square with a transparency of 95 percent over the entire visible region. Optical extinction coefficients, percent transmission, and refractive indices were determined as a function of annealing temperature and sheet resistance. Results show that the infrared reflection loss of films of indium–tin oxide can be attributed to the amount of oxygen vacancies which are incorporated into the film. (auth)

1316 ION BACKSCATTERING STUDY OF TANTALUM NITRIDE THIN FILM RESISTORS. Langley, R. A.; Sharp, D. J. (Sandia Labs., Albuquerque, NM). J. Vac. Sci. Technol.; 12: No. 1, 155-159(1975).

Ion backscattering was used to characterize thin film tantalum nitride resistors with thicknesses in the range 500–600 A. The amount of surface oxide, the nitrogen content, its depth distribution, the amount of argon-sputtering gas incorporated into the film, and its depth distribution, are measured directly by the technique. The films were prepared by diode sputtering in a pilot line facility. All sputtering parameters were held constant except for the N_2 flowrate, which was varied so as to change the nitrogen concentration in the films. The electrical properties of the films were characterized by measurements of the sheet resistance and the differential Seebeck voltage. Aluminum oxide substrates were used for the electrical measurements and beryllium substrates with thin oxide layers were used for the backscattering compositional analysis. As the N concentration decreased below the stoichiometric composition Ta_2N to the composition $Ta_2N_{0.5}$, the resistivity was found to decrease linearly by 25 percent and the differential Seebeck voltage to increase linearly by 90 percent. (auth)

1317 ATOMIC IMPLANTATION OF Nb IN AMORPHOUS Nb_2O_5 BY RF SPUTTERING. Fuschillo, N.; Lalevic, B.; Annamalai, N. K. (Rutgers Univ., New Brunswick, NJ). J. Vac. Sci. Technol.; 12: No. 1, 52-55(1975).

It is shown that amorphous Nb_2O_5 films 2400 A thick produced by anodization can be doped with Nb by rf sputtering of Nb atoms at substrate temperatures of 150°C. Large increases in electrical conductivity, reductions in thermal activation energy, and increases in capacitance as function of sputtering voltage in the range 2–5 kV support this interpretation. The high-field conduction process also changes from the Poole–Frankel mechanism often found in insulating films, where the conductance G equals G_0 exp(KV/sup ½/) to the Poole mechanism where G equals G_0 exp(KV) found in Nb doped films. The doping concentration for 2400-A films was calculated using the experimental values of the exponent K and found to be 10^{19} atoms/cm^3 for films sputtered with Nb at an rf voltage of 3 kV. Capacitance variation as a function of voltage and temperature also support these conclusions. These effects are interpreted on the basis of possible implantation and temperature-aided diffusion process. (auth)

1318 ENDOR OF $^{171}Yb^{3+}$ AND $^{173}Yb^{3+}$ ON CUBIC SITES IN ThO_2. Baker, J. M.; Olson, D. N. (Oxford Univ.). J. Phys., C (London); 8: No. 3, 361-369(7 Feb 1975).

ENDOR of Yb^{3+} in ThO_2 has given similar results to those in CaF_2. The measurements were used to determine the energies of the excited states of the lowest $J = ½$ manifold of Yb^{3+}, showing that the crystal field in ThO_2 is almost identical to that in CaF_2. This is in excellent agreement with the predictions of the superposition model of Newman, where the crystal field is dominated by covalent contributions from the ligands. In particular the energy of the Γ_8 state is 605(3) cm^{-1}, which becomes 650 cm^{-1} if a similar correction is applied to that necessary in CaF_2. The ENDOR linewidth of ~60 kHz is significantly narrower than that in CaF_2, which has allowed the determination of a somewhat more precise value of the hyperfine structure anomaly, $\Delta = -0.007(8)\%$. This leads to a ratio of s to f electron contributions to the hyperfine structure, $A_s/A_f = +1.9 \pm 2.2\%$ consistent with the prediction of zero by Watson, Bagus and Freeman, but in disagreement with Bleaney. It is different from a recalculated value of $A_s/A_f = +5.5 \pm 3.6\%$ for CaF_2, probably because of the difference of covalency in the two materials. The difference in sign between the value of A_s/A_f determined from Δ and that determined in CaF_2 by a different method by Sabisky and Anderson, which was first noted by Baker, Blake and Copland, has been confirmed. (auth)

1319 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF ARTICLES COATED WITH SILICON CARBIDE. Ford, L. H.; Davidge, R. W.; Evans, A. G. (to Twentieth Century Electronics Ltd.). British Patent 1,367,466/B/. 18 Sep 1974. Filed Date 8 Jan 1971. 5p.

Reference is made to methods for the production of SiC-coated nuclear fuel particles. It has been found that a dense high strength SiC coating can be produced by vapor deposition at a low rate, but such a technique increases the time required to complete the coating cycle and hence the overall cost of production. The method described involves vapor deposition of a coating of pyrolytic SiC onto a C-coated nuclear fuel particle in such a way that the outer layers are deposited at a lower rate than the inner layers. The pyrolytic SiC can be deposited from the vapor phase as a coherent coating using various combinations of Si- and C-containing compounds, but the reduction of methyltrichlorosilane in a fluidized bed has been found the most convenient process for deposition of such coatings on C-coated nuclear fuel particles, and apparatus for this is described. In a typical example, deposition was initially carried out at a rate of about 1 μm/min. for a 50 μm coating, and this was reduced to about 0.1 μm/min. whilst depositing the final 5μ. Surface refinement may be carried out in the temperature range 1400 to 1600°C. Strength data are given. (UK)

1320 X-RAY BAND SPECTRA AND ELECTRONIC STRUCTURE OF CARBIDES AND NITRIDES OF ZIRCONIUM, NIOBIUM, AND MOLYBDENUM. Nemoshkalenko, V. V.; Krivitskii, V. P.; Nesenjuk, A. P.; Nikolajev, L. I.; Shpak, A. P. (Inst. of Metal Physics, Kiev). J. Phys. Chem. Solids; 36: No. 4, 277-281(Apr 1975).

The L- and M-emission spectra of Zr, Nb, and Mo carbides and nitrides have been studied. The spectra were excited by primary techniques. It is concluded that the valence bands of these carbides

and nitrides consist of two sub-bands: a sub-band of states which participate in covalent bonds and a sub-band of states which share in the formation of metallic bonding and account for the metallic properties of these phases. (auth)

1321 METHODS OF APPLYING FISSION PRODUCT RETAINING COATINGS TO NUCLEAR FUEL PARTICLES. Lefevre, R. L. R. (to United Kingdom Atomic Energy Authority). British Patent 1,371,268/B/. 23 Oct 1974. Filed date 22 Mar 1972. 3p.

A method is claimed for applying a layer of SiC on a pyrolytically deposited layer of pyrolytic carbon so that the overcoating layer has a smooth interface with the substrate. A thin layer of SiC is first applied to the surface of the pyrolytic carbon to fill in irregularities in the surface, a layer of pyrocarbon is then deposited on this SiC, this layer being thinner than the SiC layer, and a thick layer of SiC is finally deposited on the pyrocarbon. A further layer of pyrocarbon may be deposited on the SiC. (UK)

1322 MONOCRYSTALS BASED ON A STABILIZED ZIRCONIUM OR HAFNIUM DIOXIDE AND METHOD OF PRODUCTION THEREOF. Alexandrov, V. I.; Osiko, V. V.; Tatarintsev, V. M.; Udovenchik, V. T. (to Ordena Lenina Fizichesky Institut Imeni P. N. Lebedeva Akademii Nauk SSSR). British Patent 1,373,888/B/. 13 Nov 1974. Filed Date 15 Dec 1972. 8p.

An improved method is described for the production of ZrO_2 or HfO_2 monocrystals stabilised with Y_2O_3. Their composition is 70 to 90 mol.% ZrO_2 or HfO_2 with 30 to 10 mol.% Y_2O_3. They may also contain oxides of transition or rare earth elements to the extent of 0.01 to 5% by weight. The charge is melted and the monocrystals are obtained from the melt by the Stockbarger process. The growth rate is 2 to 30 mm per hour. The crystals have good optical properties and have a cubic structure. (UK)

1323 DEPOSITION OF SILICON CARBIDE. Voice, E. H. (to United Kingdom Atomic Energy Authority). British Patent 1,373,783/B/. 13 Nov 1974. Filed Date 7 Oct 1971. 2p.

A method is described for applying a SiC coating to nuclear fuel particles in a fluidised bed by contacting with a vapor that yields SiC on pyrolysis, in the presence of an additive that has the effect of reducing the grain size of the SiC without substantially altering its chemical composition. Amongst suitable additives is N_2. A carrier gas, such as H_2, is used to convey methyl trichlorosilane vapor into contact with a fluidised bed of nuclear fuel spheroids within a furnace heated to a pyrolysis temperature. N_2 is added to the atmosphere in proportion 10 to 20% by volume. P is also a suitable additive, and in this case it is preferable to convey the P to the furnace via the carrier gas, which is bubbled through a suitable P compound, such as PU_3. Other additives are mentioned. (UK)

1324 DIE SETS FOR COMPACTING GRANULAR MATERIAL. Werner, D. A. (to United Kingdom Atomic Energy Authority). British Patent 1,367,352/B/. 18 Sep 1974. Filed Date 12 Jul 1971. 4p.

Reference is made to die sets for producing annular compacts of granular fissile material for nuclear reactor fuel elements. Such compacts may comprise, for example, graphite-coated oxide particles incorporated in a matrix of graphite powder and a phenolic resin. Drawbacks of die sets conventionally used are stated. The improved die set described comprises two coaxial cylinders that bound a compaction space, two opposing annular plungers slidable within the space, two opposing pairs of coaxial helical coil compression springs placed so as to act between the ends of the cylinders and the plungers, and means for limiting the degree of compaction. By floating both inner and outer cylinders between springs, a compact of more uniform density is obtainable using a lower compacting pressure and thus reducing damage to the graphite coatings of the oxide particles. (UK)

1325 SINTERED ZIRCONIA BODIES. Hancock, J. D.; Hepworth, M. A. (to Magnesium Elektron Ltd.). British Patent 1,374,832/B/. 20 Nov 1974. Filed Date 11 Apr 1972. 4p.

A method is described for making sintered ZrO_2 articles comprising sintering a compacted composition consisting of 10 to 100% baddeleyite, the remainder being pure ZrO_2 or additives. At least 10% of the composition should have an average grain size not greater than 5μ. The sintering temperature is 1550 to 1650° and the sintering time 2 to 3 hours. The mixture should preferably contain up to 2 mole % of Y_2O_3 to stabilize the product against the destructive volume changes that occur with dense ZrO_2 bodies. The mixture may also contain up to 15 mole % CaO and/or MgO. A suitable lubricant, such as polyethylene glycol wax, may also be incorporated. (UK)

1326 YTTERBIUM DIBORIDE. Bauer, J. (Institut National des Sciences Appliquees (INSA), 35 - Rennes (France)). Compt. Rend., Ser. C; 279: No. 12, 501-504(16 Sep 1974). (In French).

Ytterbium diboride was prepared by heating the elements in sealed Ta crucibles. The diboride is of the AlB_2 type as all the diborides of the yttrium group. (FR)

1327 PREPARATION, CHARACTERIZATION, AND MAGNETIC PROPERTIES OF Sm_2O_3. Bernier, J. C.; Lejus, A. M.; Collongues, R. (Ecole Nationale Superieure de Chimie, Strasbourg). Solid State Commun.; 16: No. 4, 349-353(15 Feb 1975). (In French).

Single crystals of Sm_2O_3 with monoclinic B structure were prepared by the Verneuil process adapted to a plasma torch. Some properties of these crystals were studied (cleavage, hardness...), especially the magnetic properties. Paramagnetic susceptibilities measurements were performed for various orientations of the crystal with respect to the magnetic field at constant temperatures (5, 77, 300°K) as well as at increasing temperatures (5 to 1000°K) and indicate an anisotropy. An interpretation of this phenomena is proposed. (auth)

1328 RADIATION DAMAGE IN OXIDES. II. Defect Formation in CaO and SrO. Tench, A. J.; Duck, M. J. (UKAEA, Harwell, Eng.). J. Phys., C (London); 8: No. 3, 257-270(7 Feb 1975).

The formation of cation and anion vacancies was studied in high purity CaO and SrO powders after irradiation by 20-MeV protons. The rate of formation of cation vacancies fits a model of interstitial–vacancy recombination. Isochronal annealing curves show that the isolated vacancy concentration is enhanced by thermal treatment at temperatures just below those at which the isolated vacancy begins to disappear. This is interpreted in terms of the decomposition of a vacancy–vacancy or vacancy–impurity aggregate. At slightly higher temperatures (640°K for CaO), the isolated vacancy is converted to the vacancy–hydroxyl ion complex and isothermal data indicates close to 100% conversion. At higher temperatures the vacancy–hydroxyl ion complex is destroyed. The probable mechanism of the first process is vacancy diffusion with an activation energy of 1.8 eV, to a hydroxyl ion where the vacancy is trapped and partial charge compensation occurs. At higher temperatures it seems likely that diffusion of interstitial cations to the vacancy occurs with an activation energy of 3.1 eV. The efficiency of vacancy production is an order of magnitude less than that predicted for primary displacements, confirming the importance of recombination between vacancies and those interstitials formed within a critical volume around the vacancy. (auth)

Metals and Alloys

1329 (AGN-8273) EVALUATION OF HASTELLOY X AS A NUCLEAR CLADDING. Monthly Progress Report for February 1968. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Div.). Mar 1968. Contract AT(04-3)-368. 5p. Dep. NTIS $4.00.

Status of oxidation tests and mechanical property evaluation of Hastelloy X is given. (DLC)

1330 (FZK-373) EVALUATION OF INSULATION MATERIALS AND COMPONENTS FOR USE IN A NUCLEAR RADIATION ENVIRONMENT. Redesign of Propellant Heating Experiment and Radiation Analysis of Saturn V Materials, Systems, and Components. First Quarterly Progress Report, 21 May–31 August. (General Dynamics/Fort Worth, Tex. (USA)). 15 Sep 1970. 40p. Dep. NTIS $5.00.

Research results are reported on propellant heating, and radiation effects on Saturn V materials. Sections are included on nuclear flight systems concepts, computer codes, reusable nuclear shuttle propellant storage, evaluation of Saturn V materials, and radiation environment evaluation. (JRD)

1331 (ORNL-TM-920) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1964. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Sep 1964. Contract W-7405-eng-26. 141p. Dep. NTIS $10.25.

Activities in research programs are summarized on fuel element development, mechanical properties of structural materials, nondestructive testing, diffusion and reactions in solids, zirconium metallurgy, and irradiation effects on structural materials. (JRD)

1332 (ORNL-TM-1500) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1966. Patriarca, P. (Comp.).

(Oak Ridge National Lab., Tenn. (USA)). Jun 1966. Contract W-7405-eng-26. 149p. Dep. NTIS $10.50.

Research activities are summarized on precipitation in nuclear materials, fuel element fabrication, nondestructive testing, zirconium metallurgy, properties of fission products, properties of fuel materials, and radiation effects on structural materials. (JRD)

1333 (ORNL-TM-1570) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1966. Patriarca, P. (Comp.). (Oak Ridge National Lab., Tenn. (USA)). Sep 1966. Contract W-7405-eng-26. 108p. Dep. NTIS $8.25.

Research activities are summarized on precipitation in nuclear materials, fuel element fabrication, nondestructive testing, zirconium metallurgy, SAP, weldability of Ni-bearing alloys, properties of fission products and fuel materials, and radiation effects on structural materials. (JRD)

1334 (ORNL-TM-1700) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1966. Patriarca, P. (Comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1966. Contract W-7405-eng-26. 192p. Dep. NTIS $12.75.

Research activities are summarized on precipitation in nuclear materials, fuel element fabrication, nondestructive testing, zirconium metallurgy, SAP, weldability of Ni-bearing alloys, properties of fission products and fuel materials, and radiation effects on structural materials. (JRD)

1335 (ORNL-TM-1720) FUELS AND MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending December 31, 1966. Patriarca, P. (Comp.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1967. Contract W-7405-eng-26. 114p. Dep. NTIS $8.25.

Research activities are summarized on precipitation in nuclear materials, fuel element fabrication, nondestructive testing, zirconium metallurgy, SAP, weldability of Ni-bearing alloys, properties of fission products and fuel materials, and radiation effects on structural materials. (JRD)

1336 (ORNL-TM-1825) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1967. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). May 1967. Contract W-7405-eng-26. 122p. Dep. NTIS $9.25.

Declassified 21 Aug 1974.

Activities in research programs are summarized on controlled precipitation in nuclear materials, fuel element fabrication development, nondestructive test development, SAP development, Zr metallurgy, weldability of Ni alloys, radiation effects on fuels, and radiation effects on structural materials. (JRD)

1337 (RDT-M-5-21T) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY PLATE, SHEET, AND STRIP (AMS 5596 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Apr 1975. 4p. RSO Free.

(This issue supersedes the Jan. 1972 issue of RDT-M-5-21T.) This standard covers Ni–Cr–Mo–Nb alloy for nuclear and associated applications other than those under the jurisdiction of the ASME Boiler and Pressure Vessel Code. (DLC)

1338 (TID-26740) HISTORY OF THE DEVELOPMENT OF ZIRCONIUM ALLOYS FOR USE IN NUCLEAR REACTORS. Rickover, H. G.; Geiger, L. D.; Lustman, B. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Naval Reactors). 21 Mar 1975. 84p. Dep. NTIS $7.25.

The technical problems and the major decisions made during the early development of zirconium alloys for use in naval reactors are outlined. A summary is given of the development of commercial sources of supply for zirconium and hafnium metal over the period 1950 to 1965, and the problems encountered in obtaining zirconium needed for early naval prototype and shipboard reactors are identified. Steps taken in the Government procurement process are described and statistics on production amounts, prices, and inventory are included. Also included are the technical aspects associated with the development of zirconium for water-cooled nuclear reactors, beginning in early 1949 when the Bettis Atomic Power Laboratory was established as a part of the Naval Reactors Program. While in the course of the next 25 years, small-scale investigations were performed on other potential core structural materials such as stainless steel, niobium, aluminum, and beryllium, the pressure for continual development, improvement, and application of zirconium was predominant and unrelenting. (PMA)

1339 (WANL-TMI-1763) SUMMARY PROGRESS REPORT AND EVALUATION, PRODUCT DEVELOPMENT PROGRAMS FOR 1966. Goldberg, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 28p. Dep. NTIS $4.50.

Activities in research programs are summarized on liquid metals, carbide fuels, nuclear rocket fuels, high-temperature semiconductors, composite materials, vapor deposition, and electron beam welding. (JRD)

1340 NOTES ON LOW RADIOACTIVITY LEAD FOR VERY LOW BACKGROUND SHIELDS. Bartels, O. G. (Univ. of Massachusetts, Amherst). Health Phys.; 28: No. 3, 189-196(Mar 1975).

Data were collected and new samples of lead were counted. The purpose was to pick out low radioactivity lead for very low background shields. It should be possible to reach 0.100 count/min/cm^3 of NaI(Tl) crystal. The data indicate that ^{210}Pb content has very little influence on the γ activity of lead. The activity contributed by thorium and its daughters was previously overlooked. A survey of the radioactive elements that may be present and their probable behavior during pyrometallurgical and electrolytic refining was made. Calculations of the activities that various elements would produce were made. The article closes with methods and criteria for selecting low radioactivity lead. The necessity of removing the neutron flux when trying to secure the lowest background was emphasized. The use of magnesium oxychloride cement for this purpose was proposed. (auth)

1341 REACTION OF CONTACT ALLOYS WITH TUNGSTEN DURING FORMATION OF ALLOY CONTACTS ON SILICON. Kozlov, Yu. I.; Abramov, A. A.; Lovtsov, D. P.; Rubinchik, E. A.; Korol'kova, G. D.; Naumkin, A. P. (All-Union Electrotechnical Inst., Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1317-1318(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1529-1530(Aug 1974).

A study was made of the reaction of fused contact alloys at the interface with a W thermocompensator during the formation of a rectifying or nonrectifying contact on a Si surface. The systems W/Al–12 wt % Si/Si and W/Ag–1 wt % Sb/Si were used. The phases formed during the diffusion at 800-900°C were studied using x-ray and metallographic analysis, and microhardness and thermo-emf measurements. (DLC)

Corrosion and Erosion

Refer also to abstracts 1387, 2174, 2416, 2714, 2808, and 2831.

1342 (NTIS/PS-75/049) HYDROGEN EMBRITTLEMENT OF METALS (A BIBLIOGRAPHY WITH ABSTRACTS). Report for 1964–October 1974. Smith, M. F. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 190p. NTIS $25.00.

The studies cover the hydrogen embrittlement of both ferrous and nonferrous metals and alloys. The research includes nuclear technology, aircraft metallurgy, mechanical properties, testing, electroplating, fatigue, corrosion, and fracture. The bibliography contains 185 abstracts. (GRA)

1343 (WANL-TMI-887) RESISTANCE TO GALLING ON HARDCOATED AND NONCOATED ALUMINUM THREADS. W. R. 00:00:75-53W (Partial Report No. 1). Zibritosky, G.; Martin, N. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Dec 1963. 2p. Dep. NTIS $4.00.

Tests were conducted to evaluate galling or seizure of hard-coated and uncoated Al thread with Al nuts. It was found that adequate performance can be achieved using Al nuts and hard-coated Al shaft. (JRD)

1344 (WANL-TMI-1104) ANALYSIS OF NOZZLE INTERFACE SEAL FAILURE. Nadler, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1964. 40p. Dep. NTIS $5.00.

A metallurgical analysis was made of Inconel X-750 nozzle interface seals which failed during fluid flow testing. The fracture was intergranular, although ductile, transgranular fracture was observed in tensile specimens taken from the part under investigation. Premature failure was attributed to the existence, prior to fluid flow testing, of intergranular cracks in concealed areas of the part which were under residual tensile stress. Cracking occurred during fabrication of the part and was the result of one or a combination of stress-corrosion, which occurred during excessive pickling of the stressed part and age hardening of stressed metal or the slow heating of such material through the age-hardening temperature range in which the grain boundary

regions of Inconel X-750 are brittle. In such instances, the superposition of thermal and aging stresses will cause fracture at the brittle carbide network in the grain boundaries. It is concluded that the successful manufacture of the part from Inconel X-750 requires a relatively high degree of care to prevent cracking. On the other hand, Inconel 718 is very attractive for this application because of its resistance to intergranular corrosion and cracking during aging, as well as its high strength. (auth)

1345 (WANL-TMI-1160) CORROSION TEST CRACKING OF SUPPORT BLOCK. Reichner, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 6p. Dep. NTIS $4.00.

Results of tests conducted on support block segments are reported. It appears that failures found in the tests were generated by mechanical loading due to start-up impact or relative expansions within the test rig or thermal shock stesses due to the start-up thermal transient and the close contact of the block segment with the cooler support structure. These two conditions should not occur in this manner under normal reactor operating conditions. To eliminate mechanical loading of the ledge, the fixturing was modified to support the block segment under the periphery of the exit face. To date, approximately 70 tests have been run of this configuration with no cracking of the block segments. (JRD)

1346 (WANL-TNR-192) EXPERIMENTAL INVESTIGATION OF THE RE-ENTRY BEHAVIOR OF METALS AND ALLOYS. Pinchok, R. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Dec 1964. 42p. Dep. NTIS $5.25.

An experimental investigation was made of the re-entry behavior of a series of metals and alloys as important structural materials in the NERVA reactor. The re-entry behavior of one-half inch models was examined in a plasmajet facility. The materials were aluminum 6061-T6, aluminum alloy 2219-T852, titanium A 110-At, stainless steel 304-A, Inconel-X750, and beryllium. The following conclusions are: (1) The ablation of aluminum, aluminum alloy, and titanium is determined entirely by the melting process. (2) In the case of titanium and stainless steel, the presence of a thick, tenacious oxide coat on the samples surface inhibits ablation. However, on pre-oxidized stainless steel samples, where cracks and spalling of the oxide layer were evident, the ablation process is accelerated. (3) Rates of oxidation of all materials studied in the plasmajet system, are qualitatively similar to those in static systems. (4) The ablation of Inconel-X and stainless steel at high heating rates is similar to that of aluminum, aluminum alloy, and titanium. The following observations were also made: (1) At low heating rates, Inconel-X and stainless steel underwent "incomplete ablation," which is attributed to (a) a change in sample geometry which changed the total heating rate to the sample and (b) a change in position of the stagnation point which diminished the heating rate to the sample. (2) The ablation of beryllium required more heat than was theoretically predicted. The reasons advanced for this phenomenon were: (a) the heating rate to the sample was lowered as a result of a change in sample geometry during early ablation and a change in position of the stagnation point (see (1) above) and (b) a phase change may have occurred in the temperature range 1240-1260°C. (3) Experimental aerodynamic stagnation point heat transfer data were obtained and agreed best with the theory of Ferri, et al. However, at Reynolds numbers less than 50, the experimental data deviated considerably from all aerodynamic theories. (auth)

1347 (WARD-3045T-1-5) SODIUM TECHNOLOGY PROGRAM. Progress Report for the Period Ending July 31, 1972. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1972. Contract AT(11-1)-3045. 106p. AT.

Activities in research programs are summarized on wear of FFTF materials in Na, self welding properties of FFTF materials, C and N transfer in reactor structural materials, properties of coatings and other wear resistant surfaces considered for FFTF applications, and on-line meter characterization. (JRD)

1348 REACTIONS OF VIa AND Va METALS WITH OXYGEN, WATER VAPOR, AND AIR AT HIGH TEMPERATURES AND LOW PRESSURES. Jehn, H. (Max-Planck-Institut fuer Werkstoffwissenschaften, Stoccarda, Ger.). Met. Ital.; 66: No. 12, 651-658 (Dec 1974). (In Italian).

A review is presented on the reactions of tungsten, molybdenum, tantalum, niobium, and vanadium with oxygen, water vapor, nitrogen, and air in the different temperature and pressure ranges. Recent results in this field are also examined. The metal losses of tungsten and molybdenum during annealing in oxygen, water vapor, and air at 1100 to 2400°C and 10^{-4} to 10^{-2} torr, are investigated and compared with corresponding results of tantalum and niobium. Furthermore the oxygen absorptions of tantalum, niobium, and vanadium in a water vapor at 1100 to 1800°C and 10^{-5} to 10^{-2} torr are reported. (auth)

1349 CORROSION OF WELDED JOINTS OF INCOLOY 825 (C = 0.5%) IN SOLUTIONS OF H_2SO_4, NH_4F, AND HF. Bernabai, U. (Univ., Rome); de Gregorio, G. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 19-25(Jan 1974). (In Italian).

Corrosion tests of welded joint specimens of Incoloy 825 (C = 0.05%) were carried out in H_2SO_4, NH_4F and HF solutions. Knife Line Corrosion (KLC) was observed in HF solutions, and the influence of heat treatments on KLC and the heat treatment procedures to eliminate KLC were investigated. (auth)

1350 STABILITY OF THE STRUCTURE IN SURFACE LAYERS OF THE Ni_3Al-Ni_3Nb EUTECTIC ALLOY UNDER CONDITIONS OF OXIDATION. Bokshtein, S. Z.; Gubareva, M. A.; Kishkin, S. T.; Moroz, L. M. Dokl. Akad. Nauk SSSR; 218: No. 6, 1327-1328(21 Oct 1974). (In Russian).

The structure stability of the surface layers of the Ni_3Al-Ni_3Nb eutectic under oxidation conditions was studied by metallographic and autoradiographic methods. The degree of structural deficiency was evaluated from the diffusion permeability. The oxidation was carried out under 5×10^{-5} torr at 900° for 30 hrs. The results showed that the surface layers even under these conditions are exposed to the aggressive action of oxygen which leads to a loss of stability and destruction of the Ni_3Nb phase. (JSR)

1351 ALLOYS FOR THE TRANSFER OF HTR HEAT INTO FLUIDIZED COAL BEDS. Kalwa, P. G. (Mannesmann-Forschungsinstitut GmbH, Duisburg, Ger.); Gala, A.; van Heek, K. H.; Wanzl, W. Trans. Amer. Nucl. Soc.; 20: 730-732(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1352 USE OF ALUMINUM ALLOYS IN DESALINATION PLANTS. Vargel, C. Trans. Amer. Nucl. Soc.; 20: 732(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1353 HELIUM RELEASE FROM VARIOUS METALS. Cost, J. R.; Hickman, R. G. (Univ. of California, Livermore). J. Vac. Sci. Technol.; 12: No. 1, 516-519(1975).

Aluminum, iron, nickel, and types 304 and 316 stainless steel were doped with helium by allowing dissolved tritium to undergo radioactive decay. Helium concentrations below 1 atomic ppM were produced. Using high-sensitivity, mass-spectrometer techniques, helium release was observed during isochronal and isothermal anneals. At least two release mechanisms are obvious, their respective gas releases occurring at widely separated temperatures. (auth)

1354 INVESTIGATIONS OF ADSORPTION ON METAL SURFACES BY PHOTOELECTRON SPECTROSCOPY, COMBINED WITH OTHER METHODS. Menzel, D. (Technische Univ., Munich). J. Vac. Sci. Technol.; 12: No. 1, 313-320(1975).

A survey is given of the experimental information which can be obtained for adsorbate layers on metals by photoelectron spectroscopy (valence level spectroscopy by UPS; quantitative analysis, and chemical shifts of adsorbate and substrate core levels by XPS), and of the difficulties arising in their interpretation. Three levels of interpretation are distinguished: a qualitative approach using the UPS and XPS spectra as fingerprints, which works best in correlation with other methods, a semiquantitative approach which tries to extract physical insight from the measured data on an intermediate level of sophistication, and as the ultimate aim, a correlation of photoelectron spectra with the spectral density obtained from many-body theories. As examples for the first approach, results for the adsorption of CO on Ru(001) and W(110), and of oxygen on W(100) are described and discussed. (10 figures) (auth)

1355 CHEMICAL EFFECTS IN THE $M_{4,5}NN$ AUGER SPECTRUM OF Mo(110) DUE TO ADSORPTION OF O_2 AND CO. Hooker, M. P. (Universal Energy Systems, Inc., Medway, OH); Grant, J. T.; Haas, T. W. J. Vac. Sci. Technol.; 12: No. 1, 325-328(1975).

Chemical effects are observed in the $M_{4,5}NN$ Auger spectrum of Mo following adsorption of oxygen monoxide on clean Mo(110). This system is particularly interesting as Auger transitions involving only core electrons; one conduction band electron or two conduction band electrons are all present over the energy range 90-250 eV. On adsorption, Auger transitions involving only core electrons shift to lower energies, whereas those involving one or two conduction band electrons undergo changes in shape. Auger spectra are presented in both derivative form N/sub m/sup (1)/(E) and following integration, N/sub m/(E). (auth)

1356 AUGER-ELECTRON SPECTROSCOPY OF HIGH-TEMPERATURE OXYGEN–RHENIUM INTERACTIONS BY AES. Weber, B.; Bigeard, B.; Mihe, J. P.; Cassuto, A. (CNRS, Nancy). J. Vac. Sci. Technol.; 12: No. 1, 338-340(1975).

Oxygen coverage theta was measured on a rhenium ribbon, in a wide temperature range (300–2200°K), with a cylindrical-mirror analyzer, while monitoring the oxygen pressure (10^{-9}–10^{-6} torr) and the rhenium trioxide formation with a quadrupole mass spectrometer. Under 5 percent coverage, theta vs p curves are linear, in agreement with an atomization reaction as the main process. Isotherm plots lead to a rhenium–oxygen atomic binding energy of 125 kcal/g atom at low coverage, while the trioxide flux indicates at higher coverage a surface reaction process, with a rate proportional to theta^3 and a linear decrease of the atomic binding energy, chi equals (125–25 theta) kcal/atom. The results are in close agreement with those previously obtained, according to a general interaction model of oxygen with transition metals. (auth)

1357 SIMULTANEOUS OBSERVATIONS OF PARTIALLY OXIDIZED SURFACES BY AES AND SIMS FOR Al, Si, Ti, V, AND Cr. Komiya, S.; Narusawa, R.; Satake, T. (ULVAC Corp., Chigasaki, Japan). J. Vac. Sci. Technol.; 12: No. 1, 361-365 (1975).

The advantage of performing simultaneous SIMS and AES analysis together with measurements of sputtering rates is demonstrated by studies of oxidized Al on Si. As the O/sub KLL/ Auger peak increases, due to increased oxygen coverage, there is enhanced emission of metal ions. Normalized SIMS and Auger signals for Al, Si, Ti, V, and Cr are intrinsic to each metal–oxygen system. From estimates of the escape depth of O/sub KLL/ Auger electrons, the mean escape depths of metal ions from oxide were estimated. A step-like decrease in sputtering rate is observed and correlated with the thickness of the oxide laye The Ag–O system was also studied and found to give an anomalo s effect. (auth)

1358 ANGULAR DEPENDENCE OF UV PHOTOELECTRON DISTRIBUTIONS FOR OXYGEN ADSORBED ON W(100). Waclawski, B. J.; Vorburger, T. V.; Stein, R. J. (National Bureau of Standards, Washington, DC). J. Vac. Sci. Technol.; 12: No. 1, 301-304(1975).

Recent theoretical work has suggested the possibility of determining chemisorption bond geometry by the use of uv photoemission. This possibility is being investigated experimentally in an apparatus which is described, and preliminary results show energy distributions as a function of emission angle for electrons photoemitted from W(100), both clean and with adsorbed oxygen. Results at hnu equals 21.2 eV for several emission angles indicate substantial angular dependence of the photoelectron distributions, not only for the clean (100) surface, but also, more dramatically, with an oxygen adlayer. (auth)

1359 STRESS CORROSION CRACKING OF A LOW ALLOY STEEL IN HIGH PURITY STEAM. Parker, J. G.; Sadler, M. A. (Central Electricity Generating Board, Bristol, Eng.). Corros. Sci.; 15: No. 1, 57-63(Jan 1975).

The catastrophic failure of a steam turbine at Hinkley Point "A" Nuclear Power Station resulted from stress corrosion cracking of the discs on the low pressure (L.P.) turbine rotor. This paper describes investigations carried out within the South Western Region of the C.E.G.B. to determine the mechanism and the environment responsible for cracking. Results show that stress corrosion cracks can be initiated and propagated during normal turbine operation and suggest that cracking is due to the action of wet, high-purity steam on stressed metal. The chemical quality of the steam was found to be very high; the impurities were well within the normal range associated with power plant operation. Results are in agreement with the recent findings of more widespread cracking at Hinkley Point and elsewhere. As the steam is inherently aggressive, the measures currently being taken by C.E.G.B. (removal of the highly stressed keyways, limiting steam access to regions of high stress, and use of improved alloys) should prevent further failures of this type. (auth)

Preparation and Fabrication

Refer also to abstract 2516.

1360 (AED-CONF-74-538-005) DEVELOPMENT OF EQUIPMENT AND METHODS FOR TYPICAL JOINING PROBLEMS IN NUCLEAR TECHNOLOGY. Lehrheuer, W.; Lison, R.; Springer, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Allgemeine Technologie). 1974. 5p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

With abstract. Available from ZAED.

Typical examples of technological joining problems in the field of nuclear technology are described. These include application of heating conductors, welding of gas or metal-filled capsules, automatic pipe and fitting welding, high-temperature brazing, and diffusion welding of high-quality steel-aluminium pipe transition pieces. (GE)

1361 (AED-CONF-74-538-011) EXPERIENCE IN THE AUTOMATIC WELDING OF THIN-WALLED ALUMINIUM TUBES. Iversen, K.; Schellong, B. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1974. 10p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

With abstract.

Problems of quality control, error detection, and other requirements in welding of thin-walled aluminium tubes for nuclear plants are discussed. (GE)

1362 (AED-CONF-74-538-026) ELECTROSLAG WELDING WITH A CONSUMABLE GUIDE PLATE AND FIBERIZED FLUX. Stark, L. E. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). 1974. 7p. (RDTPA-74-21). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

7 figs.; 2 tabs.; 7 refs. With abstract. Available from ZAED.

Electroslag weldings on 4 to 10 inch thick steel plates are described for a new electroslag welding process where a consumable guide plate is at a small distance from the base metal edges and the melting bath is covered by a slag layer. (GE)

1363 (BMFT-FB-T-74-26) DEVELOPMENT OF A PROCESS FOR THE MANUFACTURE OF P/M HIGH-TEMPERATURE SUPERALLOYS. Schmidt, O.; Horn, E.; Schubert, F. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F. R. Germany)). Oct 1974. 157p. (In German). INIS.

Using both pre-alloyed and simply blended powders, P/M high-temperature sample material was produced from Inconel 713 C and Udimet 700 as well as from CoCr–20Ni–20W (similar to ATS 113) by means of cold compacting and sintering, hot die pressing, and hot extrusion. The different steps for producing the material were supplemented by thermal and thermomechanical treatments. Compared with conventionally produced material, hot extrusion of low-oxygen powders and thermal or thermomechanical post-treatments resulted in material with improved mechanical and technological properties for test temperatures of up to 750 to 800°C. It is therefore suggested that structural parts for application in the temperature range concerned–such as jet engine discs, hubs, rings and spacers–can be successfully produced by these P/M-processes under economically favorable conditions. (auth)

1364 (RDT-M-1-19T(3-75)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM BARE WELDING RODS AND ELECTRODES (ASME SFA-5.14 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 4p. RSO Free.

A standard is given which prescribes requirements for Ni–Ch–Mo–Nb bare welding rods and electrodes for nuclear and associated applications. This standards transmittal supersedes RDT M 1-19 T, January 1972. (PMA)

1365 (RFP-2275) EXTRUSION OF THE URANIUM-0.75 WEIGHT PERCENT TITANIUM ALLOY. Jackson, R. J.; Lundberg, M. R.; Boland, J. F. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 7 Mar 1975. Contract AT(29-1)-1106. 18p. Dep. NTIS $4.00.

Procedures are described for extruding the U–0.75 wt percent Ti alloy in the high alpha region (600 to 640°C), and in the upper gamma region (900 to 1000°C). The casting of sound extrusion billets has importance in the production of sound extrusions, and procedures are given for casting sound billets up to 1,100 kilograms. Also important in producing sound extrusions is the use of glass lubricants. Reduction ratios of greater than 50 to 1 were achieved on reasonably sized billets. Extrusion constants of 48,000 pounds per square inch (psi) [296 megapascals (MPa)] for alpha phase (630°C) and 8,000 psi (56 MPa) for gamma phase (950°C) were achieved. Gamma-phase extrusion has preference over alpha-phase extrusion in that larger billets can be used and temperature control is not as critical. However alpha-phase extrusion offers better surface finish, less die wear, and fewer oxidation problems. Billets up to 14 inches in diameter have been successfully gamma-extruded and plans exist for extruding billets up to 20 inches (508 millimetres) in diameter. (auth)

1366 (RFP-2366) PLUTONIUM-241 PROCESSING: FROM IMPURE OXIDE TO HIGH PURITY METAL TARGET DISKS. Conner, W. V.; Baaso, D. L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 31 Mar 1975. Contract AT(29-1)-1106. 10p. Dep. NTIS $4.00.

The preparation of three plutonium-241 metal target disks, using a precision casting technique, is described. The disks were 0.625 inch in diameter and 0.125, 0.025, and 0.010 inch thick. All three disks were prepared simultaneously in a single casting. The variation in thickness of each disk was within +-1 percent of the disk's average thickness. The plutonium-241 was highly pure, and the finished disks contained a total of only 297 parts per million of detectable impurities. Purification of the plutonium oxide ($^{241}PuO_2$) and the conversion of the purified $^{241}PuO_2$ to metal are also described. (auth)

1367 (UCID-16771) RE-ESTABLISHING FILTERING CAPABILITIES OF MACHINED POROUS BERYLLIUM VIA CHEMICAL REDUCTION AND CLEANING. Randall, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1975. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

Porous beryllium is furnished in sheets of varying sizes and thickness; it is therefore necessary that it be machined into specified sizes. A chemical reduction and cleaning procedure was devised to remove the disrupted surface, open the sealed pores of the material, and clean entrapped contaminates from the internal structure. Dimensional stability can be closely controlled and material size is of no consequence. (auth)

1368 (WANL-TME-627) DEVELOPMENT OF AN INERT GAS (TIG) SPOT WELDING PROCESS FOR TIE PLATES. Laughner, E. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Sep 1964. 13p. Dep. NTIS $4.00.

The development of a tie plate to capsule weld is described. Three types of TIG welding processes were investigated: single-phase dc, three-phase dc, and single-phase ac. The ac automatic arc spot welding is recommended because the resulting welds were more uniform in penetration. (DLC)

1369 (WANL-TME-714) EVALUATION OF NI-SPAN-C 902 FOR NERVA FASTENERS. Levine, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Mar 1964. 54p. Dep. NTIS $5.75.

Attempts to obtain mechanical properties of NI-SPAN-C 902 (a precipitation-hardenable Fe–42 Ni–5.2 Cr–2.5 Ti alloy) bar material for bolting applications per WANL PDS 30044 have been unsuccessful when the material was heat treated as specified. Therefore, an evaluation of the material was performed to (1) determine the effects of various heat treatments on the mechanical properties and thermal expansion, (2) choose a more suitable heat treatment so that the material will meet the requirements of use, (3) determine the effect of a variation in size of material on the tensile properties, and (4) provide mechanical property and thermal expansion data as a function of temperature. This report discusses the results of the evaluation and the basis on which the selected heat treatment (solution anneal at 1750°F for one hour, water quench, age harden at 1350°F for three hours, and air cool) was chosen. (11 tables, 20 fig) (auth)

1370 HOMOGENIZATION OF COMPACTED BLENDS OF Ni AND Mo POWDERS. Lanam, R. D. (Olin Metals Research Lab., New Haven); Yeh, F. C. H.; Rovsek, J. E.; Smith, D. W.; Heckel, R. W. Met. Trans.; 6A: No. 2, 337-341(Feb 1975).

The homogenization behavior of compacted blends of Ni and Mo powders was studied primarily as a function of temperature, mean compact composition, and Mo powder particle size. All compact compositions were in the Ni-rich terminal solid-solution range; temperatures were between 950 and 1200°C (in the region of the phase diagram where only the Mo–Ni intermediate phase forms); average Mo particle sizes ranged from 8.4 mu m to 48 mu m. Homogenization was characterized in terms of the rate of decrease of the amounts of the Mo-rich terminal solid-solution phase and the Mo–Ni intermediate phase. The experimental results were compared to predictions based upon the three-phase, concentric-sphere homogenization model. In general, agreement between experimental data and model predictions was fairly good for high-temperature treatments and for compact compositions which were not close to the solubility limit of Mo in Ni. Departures from the model are discussed in terms of surface diffusion contributions to homogenization and non-uniform mixing effects. (auth)

1371 HOMOGENIZATION OF COMPACTED BLENDS OF Ni AND W POWDER. Tanzilli, R. A. (General Electric Co., Philadelphia); Heckel, R. W. Met. Trans.; 6A: No. 2, 329-336 (Feb 1975).

The diffusional homogenization of compacted blends of elemental Ni and W powders was studied using quantitative metallography and X-ray compositional line broadening. Homogenization treatments were carried out in the temperature range from 1156 to 1271°C (in the region of the Ni–W phase diagram where only the terminal solid solutions exist). The mean compositions of the compacts studied ranged from 0.06 to 0.14 atomic fraction tungsten (in the Ni-rich solid solution). Other variables studied included the size and shape of the W particles, compaction pressure, and the effect of applied load during the homogenization treatment. Experimental measurements of the solution of the unstable W-rich phase and the increase in W concentration in the Ni-rich matrix were compared to calculated values obtained from a concentric-sphere mathematical model which assumed volume interdiffusion (concentration-independent diffusion coefficients) and local equilibrium at the heterophase interface. The model provided a fairly good approximation of the homogenization kinetics and the effects of the major processing and powder parameters investigated. The primary sources of discrepancy between model predictions and experimental data appeared to result from modest surface diffusion contributions to homogenization and imperfect powder blending. (auth)

1372 FORMATION OF AUSTENITIC-FERRITIC STRUCTURE OF WELD METAL IN WELDING OF NIOBIUM WITH STEEL. Sivov, E. N.; D'yachenko, V. V. (Moscow Aviation Tech. Inst.). Svar. Proizv.; No. 5, 19-20(May 1974). (In Russian).

During the electron beam welding of niobium alloy VN2AE with stainless steel Cr 18 Ni 10 T with melting of the stainless steel, a weld metal structure is formed with an increased content of the ferritic component. The amount of ferritic component is determined by the concentration of alloying elements in the weld metal, which depends on the temperature and contact time of the liquid and solid phases. The structure of the weld metal without interstratification of the intermetallics corresponds basically to the structure of the Cr 18 Ni 10 T stainless steel. In the narrow zone on the niobium side (~0.1 mm) the ferrite content increases to 8%. In the case that interstratification of intermetallics takes place, the metal weld structure is almost austenitic-ferritic over the entire cross-section, and the maximum content of ferrite is as high as 45%. (tr-SJR) (auth)

1373 MORPHOLOGICAL VARIATION OF CADMIUM CRYSTALS GROWN FROM THE VAPOR. Madono, M. Madison, WI; Univ. of Wisconsin (1974). 144p. University Microfilms Order No. 75-2468.

Thesis (Ph. D.).

The very high mechanical strength of the whiskers and the platelets of metals such as cadmium justifies efforts to determine the optimum growth conditions for these crystal shapes. To do so, crystals have to be grown in a system in which growth parameters are accurately measured. Furthermore, to understand the formation of different crystal shapes, from the initial stage of crystal growth, the growth process must be directly observed. Price's pioneering approach (Phil. Mag., 5(1950) 473) to direct observation and to accurate determination of growth parameters prompted the present investigation. In a cell filled with pre-purified hydrogen, cadmium crystals were grown from the vapor. The pyrex fiber substrate was placed perpendicular to the temperature gradient. As a result, crystals growing on the substrate manifested the morphology under a single condition of supersaturation and temperature. Growth temperature was directly measured by a thermocouple located next to the substrate. Supersaturation was calculated from the two interior temperatures of the two ends of the cell. These interior temperatures were estimated from the corresponding exterior temperatures which could be directly measured. This way, supersaturation could be estimated to +-0.05. Growth temperature ranged between 260 and 320°C, and at a given temperature, supersaturation varied from 0.05 to 0.5. Only above 295°C was whisker growth active. At a supersaturation of 0.3, this whisker growth was most active. When the supersaturation was below 0.1, there was no visible crystal growth. Whiskers maintained characteristic shapes only when supersaturation was below 0.5. This upper limit of supersaturation for stable whisker growth was identified with the critical supersaturation for two-dimensional nucleation. The latter was calculated by using the surface free energy of solid cadmium, which was estimated from a reported value of solid zinc surface free energy. The estimated value of solid cadmium surface free energy was smaller than a reported value of liquid cadmium surface tension. As a result the calculated value (0.07) of the critical supersaturation for two-dimensional nucleation was much smaller than had been previously reported. The discrepancy between the critical supersaturation for two-dimensional nucleation and the observed upper limit of supersaturation for stable whisker growth was interpreted as the result of impurity adsorption on the ledge of two-dimensional nuclei. Morphological variation for supersaturation between 0.1 and 0.5 was thought to reflect character-

istics of the pyrex substrate. A probable size distribution of glass crystallites on the pyrex substrate was proposed. Occasional irregular growth was attributed to traces of oxygen and water vapor in the hydrogen atmosphere. The effects of these contaminants on crystal growth were summarized as follows: (a) increased crystal population, (b) a tendency for hexagonal blocks to become irregular nodules, and (c) enhanced whisker growth. Whisker growth was thought to be enhanced when oxygen content in a hydrogen atmosphere lay within a certain range. It was shown that hydrogen acts as a reduction agent, and thus protects cadmium from oxidation more effectively than inert gases. In conclusion, the optimum supersaturation for whisker growth was 0.3. Slight variation could be expected with different substrates. Furthermore, the active whisker growth could be further enhanced if a certain amount of oxygen was introduced in the growth atmosphere. (Diss. Abstr. Int., B)

1374 MECHANISM OF THE ELECTROPOLISHING OF MOLYBDENUM IN NONAQUEOUS ELECTROLYTES. Heumann, T.; Klimmeck, M. (Muenster Univ. (F. R. Germany). Inst. fuer Metallforschung). Werkst. Korros.; 25: No. 12, 906-909 (Dec 1974). (In German).

Measurements were carried out on molybdenum electrodes in solutions of magnesium perchlorate and lithium chloride in ethanol, dimethyl sulphoxide and dimethyl formamide. It was thus shown that the metal can be electropolished in the perchlorate containing electrolytes. The formal valency of the molybdenum solution in the electropolishing region determined from the loss in weight of the electrode and the charge flow was found to be $3 \geq n \geq 2.75$. (GE)

1375 USE OF YTTRIUM AND SCANDIUM FOR FABRICATION OF RADIOACTIVE ELECTRON EMITTERS. Singleton, J. H.; Yannopoulos, L. N. (Westinghouse Research Labs., Pittsburgh). J. Vac. Sci. Technol.; 12: No. 1, 414-418(1975).

Thin films of titanium tritide are widely used as a radioactive source of electrons of average energy approximately 5.7 keV. Because of the limited thermal stability of this tritide, such films can only be exposed to temperatures above 200°C for very short time intervals during processing or operation. The production of emitters which can be used at temperatures 100–150°C higher than those using titanium is described. The films of yttrium and scandium, of thickness 5000–12,000 A, on stainless steel substrates, contain in excess of one tritium per metal atom and yield stable electron densities of $1–2 \times 10^{-10}$ A/cm^2. The films have good adhesion and resist abrasion; they can be sheared to a desired size either before or after loading with tritium. The thermal stability of the electron emitters in vacuum, hydrogen, and a hydrogen–nitrogen mixture has been determined. The data illustrate the profound influence of surface contamination on both the loading and loss of tritium in the films. (auth)

1376 IMPROVEMENTS IN OR RELATING TO ENCAPSULATED OR CLAD NUCLEAR FUEL BODIES. Steemers, T. C. (to United Kingdom Atomic Energy Authority). British Patent 1,375,575/B/. 27 Nov 1974. Filed date 7 Oct 1971. 2p.

A factor that is thought to have a deleterious effect on oxide nuclear fuel is the formation of gases within the fuel structure and its containment during fission. Thus during the burnup of oxide fuel, O_2 that does not combine with fission products can build up gas pressure which can become excessive and which may result in damaging strains in the fuel structure or its containment. In the arrangement described, the fuel contains additions of carbide of Zr or Ti present as a separate phase, and the free O_2 either fills interstitial positions in the carbide or reacts with C to form CO. In the latter case as CO is formed it reacts with the carbide to form oxycarbide and leaves no gaseous reaction products. Methods of incorporating the carbide with the oxide fuel are described. The proportions of carbide employed depend on the burnup to which the fuel is to be subjected; about 0.25 mol.% carbide is required for each 1% FIMA (fissions per initial metal atom). Overall manufacturing details are given for the fuel bodies. (UK)

Properties, Structure, and Phase Studies

Refer also to abstracts 91, 1308, 2311, 2352, 2473, and 2685.

1377 (AD-778093) FRACTURE TOUGHNESS AND FATIGUE PROPERTIES OF TITANIUM LAMINATE COMPOSITES PRODUCED BY CONTROLLED DIFFUSION BONDING. Final Report, June 1972–August 1973. Cox, D. O.; Tetelman, A. S. (Failure Analysis Associates, Stanford, Calif. (USA)). Oct 1973. 46p. (AFML-TR-73-288). NTIS $5.50.

An investigation of the use of laminate composites containing a weak interface to increase the fracture toughness of high strength titanium alloy has been conducted. Two billets were fabricated from 0.010 inch Ti–6Al–4V material using a diffusion bonding process. Thin metal foils were used as interleaf materials. Results indicate that the use of a 0.0015 inch Al foil as an interleaf leads to delamination ahead of the crack tip in the arrester orientation, and effectively blunts the crack. It was found that a 0.001 inch commercially pure titanium foil used as an interleaf will not lead to delamination and splitting. Diffusion during the bonding process causes formation of a uniform material with no weak interface. Therefore, no delamination or splitting could occur in the composite material. It was also found that a propagating fatigue crack can be arrested at the interface in the arrester orientation. It was also determined that the crack growth rates of material which splits in the divider orientation are similar to rates obtained from full strength material. (GRA)

1378 (AD/A-002135) RCo_5 COERCIVITY. Technical Report, 1 July 1972–4 June 1974. Searle, C. W.; Garrett, H. J. (Dayton Univ., Ohio (USA)). Aug 1974. Contract F33615-73-C-5020. 66p. (AFML-TR-74-156). NTIS $4.25.

Hysteresis loops associated with single crystals of $Nd_{1-x}Sm_xCo_5$ were experimentally investigated. Results lead to a theoretical model which could describe the experimental data. The model was further refined and checked which put it on firm experimental grounds. The state-of-the-art production process for $SmCo_5$ sintered permanent magnets was analysed in terms of the model. An alteration of the production process is presented which could result in better permanent magnets. (GRA)

1379 (AD/A-002137) BIAXIAL STRENGTH TESTS ON BERYLLIUM AND TITANIUM ALLOYS. Final Report, July 1971–April 1974. Lindholm, U. S.; Yeakley, L. M.; Davidson, D. L. (Southwest Research Inst., San Antonio, Tex. (USA)). Jul 1974. Contract F33615-71-C-1608. 56p. (AFML-TR-74-172). NTIS $4.25.

Results of extensive biaxial testing of two new grades of beryllium and two titanium alloys, 6Al–4V and 6Al–6V–2Sn, are presented. The tests are conducted on thin-walled tubular specimens subject to combinations of axial load, torsion, and internal pressure. Results include description of the yield, plastic flow, and failure properties of these alloys under plane stress conditions. In each case, yield and plastic flow is adequately described by a mises yield criterion and associated flow rule. Tensile failure is more accurately described by a maximum stress criterion, particularly for the beryllium which has low ductility. Biaxial ductility is shown to be very sensitive to both the form of the failure stress criterion and to the strain hardening modulus of the material. The effect of prestraining on subsequent ductility in beryllium is examined. (GRA)

1380 (AD/A-002488) INVESTIGATION OF THE EFFECT OF MICROSTRUCTURE ON THE CREEP BEHAVIOR OF EUTECTIC ALLOYS. Technical Report, November 1973–November 1974. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Nov 1974. Contract N00014-71-C-0393. 37p. (UARL-N-911184-10). NTIS $3.75.

The effect of matrix heat-treatment on the creep resistance of five Ni_3Nb–Ni_3Al eutectics was studied. Results showed that the specimens possessed excellent uniformity and the creep test results were very reproducible. The five compositions were ranked according to their creep resistance. Although there was little effect of heat treatment at the temperature studied, the accurate creep data obtained are informative for alloy future development. A possible deformation and fracture mode was identified and is being investigated in detail. (GRA)

1381 (AD/A-003014) MAGNETIZATION, MAGNETOCRYSTALLINE ANISOTROPY AND MAGNETOSTRICTION IN SOME RARE-EARTH–COBALT COMPOUNDS, R_2Co_{17}. Miller, A. E. (Notre Dame Univ., Ind. (USA)). Dec 1974. Contract N00014-67-A-0242-0007. 45p. NTIS $3.75.

The magnetocrystalline anisotropy and magnetostriction behavior of the rare earth–cobalt intermetallics $Lu_xTm_{2-x}Co_{17}$ and $Y_xDy_{2-x}Co_{17}$ ($x = 0.2/3.4/3.2$) were determined from measurements performed on large single crystals. Magnetization measurements were performed with a vibrating sample magnetometer and the magnetostriction was measured by standard strain gage techniques. Measurements were made from 77K to 500K in magnetic fields to 12,000 Oe. (GRA)

1382 (AED-CONF-74-538-008) PROPERTIES OF TYPE 1811 CrNi ss AND PARENT-LIKE WELD JOINTS WITH REGARD TO ELEVATED TEMPERATURE APPLICATION. Grosser, E. D.; te Heesen, E.; Lorenz, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1974. 8p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

19 figs.; 1 tab.; 16 refs. Available from ZAED.

Material characterization, thermal stability of microstructure, tensile properties, and ductility in as-received and aged condition are discussed for type 1811 Cr–Ni stainless steel. Also studied were the effects of strain rate on tensile properties, creep properties, low-cycle fatigue behavior, and fracture mechanics. Experience in steel applications are discussed. (GE)

1383 (AED-CONF-74-538-019) MEASUREMENTS PERFORMED ON THE TEMPERATURE DISTRIBUTION IN THE HEAT-AFFECTED ZONE OF SEAM WELDS AND CLADDINGS. Klausnitzer, E.; Belicic, M. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). 1974. 7p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Temperature-time curves in the heat-affected zone of submerged wire seam welds and band weld claddings were determined and evaluated. A thick-walled forging of 22Ni–Mo–Cr37 was used and instrumented with weld-on thermocouples. (auth)

1384 (AGARD-CP-156) SPECIALISTS MEETING ON DIRECTIONALLY SOLIDIFIED IN-SITU COMPOSITES, WASHINGTON, DC, APRIL 23–24, 1974. Thompson, E. R.; Sahm, P. R. (eds.). (Advisory Group for Aerospace Research and Development, 92–Neuilly-sur-Seine (France)). 1974. 170p. (In French and English). (CONF-740496-).

Twelve papers were presented at the meeting. A separate abstract was prepared for each of six papers. Papers for which no abstracts were prepared are concerned with solidification of oriented binary phases in composite materials, growth of directionally solidified composites, production of aligned composites, composite configurations, phase equilibria in composites, and component design for use of directionally solidified composites. (JRD)

For abstracts of individual papers see: 1282–1285, 1385, and 1386.

1385 (AGARD-CP-156, pp 13-20) STRUCTURE AND THERMAL STABILITY OF EUTECTIC ALLOYS. Weatherly, G. C. (Univ. of Toronto). 1974.

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

The factors that control the as-grown morphology, crystallography, and thermal stability of uni-directionally solidified eutectic alloys are briefly reviewed. The crystallographic orientation relationships that are usually found in these alloys are considered only in their bearing on the thermal stability problem. The stability of rod morphologies and the possible coarsening mechanisms in faulted and perfect arrays of parallel rods are discussed for the extreme cases of diffusion and interface-controlled reactions. The coarsening mechanisms in lamellar eutectics are simpler and are controlled by the faults grown-in during solidification. The roles of lamellar terminations, sub-grains and discontinuous coarsening at migrating grain boundaries are considered. Problems encountered in phase stability of carbide reinforced nickel based superalloys during that hot tensile deformation, are reviewed. (auth)

1386 (AGARD-CP-156, pp 131-139) OXIDATION, HOT-CORROSION, AND PROTECTION OF DIRECTIONALLY SOLIDIFIED EUTECTIC ALLOYS. Stringer, J. (Univ. of Liverpool). 1974.

From specialists meeting on directionally solidified in-situ composites; Washington, District of Columbia, USA (23 Apr 1974).

In specialists meeting on directionally solidified in-situ composites.

Results of studies show that under certain circumstances the presence of a second phase which may form a thick oxide can have very severe effects on the overall oxidation of a composite. It depends on the spacing of the second phase particles, and their shape, and also on the relative rates of growth of the oxides and of diffusion in the phases of the alloy. Various mechanical properties are also important, including the adhesion between the oxides and the substrate, the grain-boundary cohesion in the phases, and the phase boundary adhesion. The phase boundaries, or one of the phases, may provide rapid diffusion paths for reactants, and furthermore may provide environments for reactions not normally expected—as in the case of the formation of $CrCl_2$ in the reducing environment within the Co–Cr–C alloys after chlorine has been able to diffuse along the carbide/matrix boundaries. Relatively little work has yet been done on the oxidation and hot-corrosion of directionally-solidified eutectic alloys, but it seems possible that there may be particular temperature ranges where the oxidation resistance may be poor, and these ranges may be quite narrow. It is therefore important to determine the oxidation resistance over a wide temperature range; and these experiments should be continued for a long time, since results of experiments have shown that two-phase structures can develop unstable oxidation after a considerable period of apparently stable behavior. In particular, hot-corrosion requires careful study over a wide range of conditions, and the effect of small amounts of sodium chloride demands particular attention. (auth)

1387 (AGN-8224) EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING. Quarterly Progress Report, 1 January–31 March 1967. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Products and Services Group). May 1967. Contract AT(04-3)-368. 97p. Dep. NTIS $8.00.

Microconstituent analysis of low and commercial cobalt tubing control specimens revealed that the primary constituent present in the matrix following aging at all temperatures (including 2000°F) is M_6C. $M_{23}C_6$ is also present as a minor phase following aging at all temperatures except 1800, 1900, and 2000°F, although it was less prominent following exposure at 1750°F. A duplex oxide film is formed on Hastelloy X at all exposure temperatures. The outer layer, as evaluated by electron microprobe analysis, was found to be rich in manganese and chromium ($MnCr_2O_4$); the inner layer is composed largely of chromium (Cr_2O_3). Very little nickel was identified in either layer. A standard x-ray diffraction pattern has been established for the $MnCr_2O_4$ outer oxide layer based upon data developed in this program. The carbide particles present in exposed Hastelloy X were analyzed by point-counting techniques. The data indicate that the composition of the carbides varies between $M_{3.5}$ and $M_{15}C$, rather than the more commonly accepted M_6C. Metallographic examination of low and commercial cobalt tubing exposed for 7500 h at 1900 and 2000°F was completed. Major differences in oxidation effects were observed between the two types of tubing. Corrosion in the low cobalt tubing was largely by internal oxidation. A major depleted zone was detected in the commercial cobalt material. This depleted zone was also present on commercial cobalt tubing examined previously and exposed at 1750 and 1800°F. The oxidation attack in all sheet specimens was similar; internal oxidation occurred but no depleted zone was observed. A uniform duplex oxide film formed on specimens exposed at 1900°F; this formation was characteristic of all the specimens examined. Severe oxide film spalling was observed on all specimens aged at 2000°F although the residual film was of the characteristic duplex form. Room temperature tensile testing of sheet and tubing exposed at 1900°F revealed a general reduction in ultimate and yield strength as a function of exposure duration. Elongation properties of the sheet material varied only slightly as a function of exposure time. The ductility of tubing was reduced to a greater degree than that of the sheet material. Data from an 1800°F, 1000-h centrifugal creep test of four Hastelloy X heats in air were analyzed. In specimens where the total strain was less than 1%, a linear relationship existed between strain and time. The linear relationship did not exist at higher total strains. The difference has been attributed, primarily, to residual stresses present in the specimens. The centrifugal creep machine was modified to permit testing in an inert gas environment. The computer code used to analyze the centrifugal creep test deflection data and to transform the data into uniaxial creep data was converted from FORTRAN II to FORTRAN IV. In the course of this conversion, some refinement was also made to improve accuracy. (auth)

1388 (CALT-822-70) SUPERCONDUCTIVITY OF NEW METASTABLE PHASES OF Nb–Ir, Ta–Ir, AND Ta–Rh ALLOYS. Johnson, W. L.; Poon, S. J. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Feb 1975. Contract AT(04-3)-822. 10p. Dep. NTIS $4.00.

Superconductivity with transition temperatures of 11.7, 10.1 and 6.6°K was observed in new metastable phases based on the Nb–Ir, Ta–Rh and Ta–Ir systems respectively. The new phases have an A-15 like structure. (auth)

1389 (CALT-822-71) STRUCTURE OF AN AMORPHOUS SUPERCONDUCTOR, LANTHANUM–GOLD. Logan, J. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Mar 1975. Contract AT(04-3)-822. 12p. Dep. NTIS $4.00.

A structural study on $La_{80}Au_{20}$ produced by rapid-quenching from the liquid state is described. Other amorphous superconductors have been produced by vapor deposition. The alloy appears to be an ideal type II superconductor (Ginzburg–Landau parameter approximately 70) with a sharp (0.2°K) transition temperature at 3.5°K, which indicates the alloy is homogeneous on the scale of the coherence length (approximately 90 A). The critical current at zero field is 10^4 Amp/cm^2 and there is a linear variation of the upper critical field with temperature. The composition range for the amorphous structure is 18 to 26 atomic percent gold. (auth)

1390 (COO-1198-1134) ELECTRIC FIELD GRADIENTS IN COPPER ALLOYS. Whalley, L. R. (Illinois Univ., Urbana (USA). Dept. of Physics). Feb 1974. Contract AT(11-1)-1198. 69p. Dep. NTIS $6.50.

The electric field gradients at Cu atoms which are near neighbors to the nickel impurity in a dilute CuNi alloy were measured. The technique used is zero field pure quadrupole resonance which was first demonstrated by Redfield [Redfield, Phys. Rev. 130, 589 (1963)]. The measured electric field gradients for this alloy system are 4.1×10^{23} cm^{-3}, 0.84×10^{23} cm^{-3}, 0.46×10^{23} cm^{-3} and 0.146×10^{23} cm^{-3}. These measured values are compared with the values calculated by Beal-Monod [Beal-Monod, Phys. Rev. 164, 360 (1967)]. In addition the following alloy systems were measured; CuCo, CuFe, and CuV. The nuclear relaxation of the alloys was measured but no satellite structure was detected. Results of these measurements show the similarity of the interactions measured here to the interactions in CuZn measured by Redfield. Since nickel has an unfilled 3d shell in its electronic structure, magnetic interactions in the CuNi alloy might be expected. Magnetic interactions were not found. Like the nickel alloy, the zinc alloy with copper exhibits no magnetic effects. (auth)

1391 (COO-1198-1152) NUCLEATION AND GROWTH OF TUNGSTEN THIN FILMS VAPOR DEPOSITED ON VACUUM-CLEAVED ROCK SALT SUBSTRATES. Asselin, G. P. (Illinois Univ., Urbana (USA)). Aug 1973. Contract AT(11-1)-1198. 101p. Dep. NTIS $8.25.

Transmission electron microscopy examination showed that the growth mode of tungsten films grown on vacuum-cleaved NaCl substrates at 350°C is of the Volmer-Weber type. The films exhibit a polycrystalline texture in the early stages of nucleation, growth, and coalescence, which disappears as the thickness of the film increases. For lower substrate temperatures, the growth mode initially is of the Stranski-Krastanov type, which then changes sluggishly to the Volmer-Weber mechanism as the thickness and temperature of the film increase. The polycrystalline texture formed is more or less perfect, depending upon the substrate temperature. At room temperature, a very weak texture is obtained, whereas, at 250°C, the texture is similar to that obtained at 350°C. Several orientations were observed during the nucleation, growth and coalescence of the tungsten film. Except for the main (100) orientation, the others could not be indexed satisfactorily. For tungsten films grown on air-cleaved preheated NaCl substrates, the growth mechanism is of the Volmer-Weber type at 350°C. At room temperature, the initial modes are the Volmer-Weber and the Stranski-Krastanov types which then change to the Volmer-Weber mode as the thickness of the film increases. The difference in growth modes between air- and vacuum-cleaved substrates at room temperature is explained in terms of the interfacial energy. The films are polycrystalline at low and high temperatures and tend to form a very weak (100) texture at high temperature (350°C). (auth)

1392 (EURFNR-1196) CHANGE IN THE MECHANICAL PROPERTIES OF CLADDING MATERIALS FOR REACTOR FUEL PINS AFTER REACTION WITH CARBIDE FUELS. Sarikaya, Y.; Goetzmann, O. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). May 1974. Translation of KFK-1993. 64p. Dep. NTIS $6.25.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The mechanical properties of all cladding materials tested change as a result of the interactions with carbide fuel, which causes them to undergo partial embrittlement. The greatest embrittlement takes place at temperatures of around 600°C. However, it does not look as if either the three steels investigated or the vanadium alloy V-3Ti-1Si are unsuitable as cladding materials for carbide pins owing to the possibility of interaction with the fuel. At high service temperatures carburization may have a favorable effect on the desired long-term properties. The low ductility of the carburized cladding at room temperature is likely to be of importance only when fuel pins are removed or reshuffled. Since their strength remains high even after carburization, the low strain values at room temperature should not cause excessive concern. Of the steels investigated, the stabilized 1.4988 type displays the best behavior with respect to the carbide fuel, i.e., its mechanical properties undergo less favorable changes as a result of the interactions with the fuel than those of the other steels. (auth)

1393 (IS-3485) FERMI SURFACE "NESTING" IN Tb ALLOYS. Burgardt, P.; Legvold, S. (Ames Lab., Iowa (USA)). 1971. 6p. Dep. NTIS $4.00.

Magnetization and electrical resistivity measurements from 4.2 to 300°K have been made on alloys of Tb with Th, Mg, and Yb in order to test valency effects on magnetic ordering in Tb. Tetravalent Th raises E/sub F/ and promotes ferromagnetism by reducing the "nesting" feature in the Tb Fermi surface. Divalent Mg and Yb lower E/sub F/ to enhance the "nesting" feature and promote the helical structure. The results are understood in terms of valency effects on the Fermi surface and impurity size effects. (auth)

1394 (KFK-2113) THERMALLY ACTIVATED DEFORMATION ANALYSIS OF VANADIUM SINGLE, AND POLYCRYSTALS BELOW FROM ROOM TEMPERATURE AND IN HIGH-TEMPERATURE RANGE OF 0.434 LESS THAN OR EQUAL TO T/T$_s$ LESS THAN OR EQUAL TO 0.528. Preininger, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1975. 153p. (In German). Dep. NTIS (US Sales Only) $10.75.

Thesis. Submitted to Karlsruhe Univ., West Germany.

Stress relaxation and strain rate measurements were made on single crystal and polycrystalline vanadium samples of different purities. The applicability of a mechanical equation of state describing dislocation motion (thermal activation analysis) was studied. At temperatures where no recovery occurs, the deformation behavior can be described with an equation of state within a scatter of ±10%, but at higher temperatures, the validity of an equation of state is not clear. (PMA)

1395 (ORNL-TM-4799) ANALYSIS OF THE DECARBURIZATION AND AGING PROCESSES IN 2¼ Cr-1 Mo STEEL. Klueh, R. L.; Leitnaker, J. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 21p. AT.

Specimens of 2¼ Cr-1 Mo steel that had been decarburized in sodium or aged in an inert atmosphere for 26,500 h at 566°C were metallurgically examined with optical and transmission electron microscopy. The carbide particle density of the decarburized and aged specimens was considerably less after 26,500 h than after 10,000 h, with the density in the aged specimen being considerably greater than that in the decarburized specimen. For the aged specimen, the density decrease was a result of Ostwald ripening, and the total amount of carbide was not noticeably affected. Decarburization, however, resulted in a gradient in carbide density, with the smallest density near the surface. Carbides were electrolytically extracted and identified by x-ray diffraction. From the before-test material, which was in the annealed condition and had a ferrite-pearlite microstructure, 1.4 wt % carbide was obtained. This sample contained M_3C, $M_{23}C_6$, and M_6C, with $M_{23}C_6$ constituting the major portion. In the aged specimen, 2.3 wt % of precipitate was extracted and contained 60% M_6C, the balance $M_{23}C_6$. The decarburized specimen contained two regions with different carbide contents. The first 20% of the 0.063-in.-thick (1.6 mm) specimen yielded 1.3 wt % precipitate, which contained 94% M_6C, the balance $M_{23}C_6$. The interior of the specimen contained 1.6 wt % precipitate, 86% M_6C. (auth)

1396 (PB-237344) STRENGTHENING MOLYBDENUM BY POWDER METALLURGICAL INTERNAL OXIDATION OF $ZrMo_2$. Research Report (Final). O'Brien, W. L.; Blickensderfer, R. (Bureau of Mines, Albany, Oreg. (USA). Albany Metallurgy Research Center). Oct 1974. 19p. (BM-RI-7958). NTIS $3.25.

Molybdenum alloys with good strength properties at elevated temperatures were produced by the powder metallurgical internal oxidation method previously applied to tungsten and known as oxyreaction strengthening. Commercial molybdenum powders were blended with 0 to 10% of a reactive powder, $ZrMo_2$. The effects of composition, blending procedure, and sintering conditions on strength properties at elevated temperatures were studied. Strengthening was attributed to zirconium in solid solution with molybdenum and to the presence of submicron particles of ZrO_2. Several alloys had tensile strength and stress-rupture properties comparable to the best commercial alloys. The maximum tensile strengths obtained were 92 kpsi at 1,2000°C and 53 kpsi at 1,316°C. The maximum stress-rupture life at 30 kpsi and 1,200°C was 145 hours. (auth)

1397 (RDT-M-1-1T(3-75)) STAINLESS STEEL COVERED WELDING ELECTRODES (ASME SFA-5.4 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 7p. RSO.

A standard prescribing requirements for stainless steel covered welding electrodes (ASME SFA-5.4 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-1T, dated July 1971. (JRD)

1398 (RDT-M-1-2T(3-75)) STAINLESS STEEL WELDING RODS AND BARE ELECTRODES (ASME SFA-5.9 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 5p. RSO Free.

A standard prescribing requirements for stainless steel welding rods and bare electrodes (ASME SFA-5.9 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-2T, dated April 1972. (JRD)

1399 (RDT-M-1-5T(3-75)) WELDING RODS AND ELECTRODES, SURFACING (AWS A5.13 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 2p. RSO Free.

A standard prescribing requirements for welding rods and electrodes, surfacing (AWS A5.13 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-5T, dated July 1971. (JRD)

1400 (RDT-M-1-11T(3-75)) NICKEL AND NICKEL-ALLOY BARE WELDING RODS AND ELECTRODES (ASME SFA-5.14 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 8p. RSO.

A standard prescribing requirements for Ni and Ni alloy bare welding rods and electrodes (ASME SFA-5.14 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-11T, dated July 1971. (JRD)

1401 (RDT-M-1-17T(3-75)) MILD STEEL ELECTRODES AND FLUXES FOR SUBMERGED ARC WELDING (ASME SFA-5.17 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 7p. RSO.

A standard prescribing requirements for mild steel electrodes and fluxes for submerged arc welding (ASME SFA-5.17 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-17T and RDT M 1-18T, dated July 1971. (JRD)

1402 (RDT-M-1-21T(3-75)) CONSUMABLE WELDING INSERTS. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 8p. RSO.

A standard prescribing requirements for consumable welding inserts for nuclear and associated applications is presented. This standard supersedes RDT M 1-21T, dated April 1974. (JRD)

1403 (RDT-M-2-7T(3-75)) CARBON AND ALLOY STEEL FORGINGS, VACUUM TREATED (ASME SA-508 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 5p. RSO Free.

A standard prescribing requirements for carbon alloy forgings, vacuum treated (ASME SA-508 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-7T, dated July 1971. (JRD)

1404 (RDT-M-7-4T(3-75)) NICKEL-CHROMIUM-IRON ALLOY ROD AND BAR (ASME SB-166 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C (USA). Div. of Reactor Research and Development). Mar 1975. 7p. RSO.

A standard prescribing requirements for Ni-Cr-Fe alloy rod and bar (ASME SB-166 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 7-4T, dated February 1973. (JRD)

1405 (TID-26773) HEAT TREAT CRACKING IN INCONEL 718, ITS CAUSE AND PREVENTION. Technical Report. Keiser, D. D, Sr. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 4 Apr 1975. 224p. Dep. NTIS $14.25.

Thesis.

Three heats of Alloy 718 were investigated for susceptibility to heat treat cracking by means of elevated temperature tensile tests. Each heat was solution annealed at three different temperatures (1750, 1900, and 2000°F) to assess effect of solution-anneal temperature. Also, each heat was given three different cooldowns (1200, 600, and 100°F/h) from solution-anneal temperature to determine the effect of cooldown on susceptibility. Tests were run both in open air and in argon. Besides unaffected base material, material given a simulated heat-affected zone (HAZ) treatment was also evaluated. Test results showed that Inconel 718 can be extremely susceptible to heat treat cracking. This generally occurs when the material is heat treated at 1900°F or above and given a fast cool (1200°F/h) following the heat treatment at these temperatures. Alloy 718 is susceptible within the temperature range of 1200 to 1600°F, with the minimum ductility occurring at approximately 1450°F. Ductility values ranging around 4 percent total elongation, based on a high temperature tensile test at 1450°F, were observed for material showing extreme susceptibility to cracking. Alloy 718 can be made immune to this type of cracking by slowly cooling the material from elevated temperatures of 1750°F and above if oxygen content, grain size, and hardening precipitate size are controlled. Heat treating in argon is beneficial if the occluded oxygen content in the 718 material is not too high. (auth)

1406 (TID/SNA-1545) FORGING AND METALLURGICAL EVALUATION OF HASTELLOY X PLATE FROM AEROJET-GENERAL CORPORATION. Report No. RD 68-102. Jahagirdar, A. R. (Wyman-Gordon Co., Worcester, Mass. (USA)). Jan 1968. 12p. Dep. NTIS $4.00.

Processing of Hastelloy in a manner similar to the Hastelloy Phoebus nozzle is described. It was found that the plate of Hastelloy X of special chemistry attained the specification minimums of Specification AGC 90056-D. The material is very sensitive to thermo-mechanical processing and a minimum amount of mechanical working (approximately 50% reduction) is necessary to obtain the optimum properties. A definite improvement in mechanical properties, grain size, and carbide distribution is obtained by forging the material. (auth)

1407 (TID/SNA-1622) CRYOGENIC TENSILE PROPERTIES OF SELECTED AEROSPACE MATERIALS. Weleff, W.; Emmons, W. F.; McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Aug 1964. 47p. Dep. NTIS $5.50.

Tensile properties data are presented on fifteen materials tested at 75, −100, −320, and −423°F temperatures. The test equipment utilized to obtain these data and test methods are described. The test results are discussed. Materials evaluated include titanium alloys 5 Al-2.5 Sn ELI and 6 Al-4V ELI; stainless steels and iron-base alloys 321, 347C, AM350, A286, and 18% Ni maraging steel; nickel-base alloys Hastelloy C, Inconel X-750, and Inconel 713-C; and aluminum alloys A356-T6, 2219-T81, 5456-0, 6061-T6, and 7079-T6. (auth)

1408 (WANL-TME-1919) SHIELDING ELECTROMAGNETIC PULSES BY USE OF MAGNETIC MATERIALS. Ferber, R. R.; Young, F. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Apr 1969. 26p. Dep. NTIS $4.50.

An experimental verification of previous theoretical work on the diffusion of saturated regions in magnetic materials has been accomplished. The diffusion times for the saturated region in Hipernom (Ni 79%-4.5% Mo-16.5% Fe) tubes have been measured for various magnetic field excitations and pulse durations. The calculated and experimentally obtained diffusion times are in excellent agreement. Excitation pulse currents up to several thousand amperes have been impressed on the test samples which varied in thickness from 5 to 18 mils. Saturation diffusion times for a 6 mil tube varied from 6 to 0.3 μs depending on the impressed magnetic field amplitude as predicted by the theory. Prior to punch through of the saturated region, little or no magnetic field leakage was detected in the interior of the test samples. (auth)

1409 (WANL-TMI-569) INVESTIGATION OF BERYLLIUM FRACTURE PROPERTIES IN ORDER TO PREDICT SAFETY MARGIN OF REACTOR COMPONENT. Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Mar 1963. 38p. Dep. NTIS $5.00.

A thermal stress problem in beryllium at cryogenic temperature is analyzed for possible fracture and the safety factor is predicted. Round notched-bar tensile tests at −320°F and other temperatures up to 212°F are reported. Values of energy release rate, G_c, are computed from the tests and used in the analysis. (auth)

1410 (WANL-TMI-1672) NOTCH TENSILE STRENGTH OF BERYLLIUM AT 140°R. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Apr 1966. 3p. Dep. NTIS $4.00.

Results of a tensile test on a notched Be specimen are presented. These results were obtained: notched tensile strength at 140°R = 20,600 psi, modulus of elasticity at 140°R ≈ 40.0×10^6 psi, and stress-strain at major diameter is linear to fracture (10,300 psi). (JRD)

1411 (WANL-TMI-1677) ADDITIONAL TEST ON NOTCHED BERYLLIUM AT 140°R (EML-82). Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 May 1966. 1p. Dep. NTIS $4.00.

Results of a notched tensile test of Be are presented. These results were obtained: notched tensile strength at 140°R = 25,600 psi, modulus (from strain gages on major diameter) = 45.5×10^6 psi, and stress-strain deviated from linearity at approximately 6000 psi. (JRD)

1412 (WANL-TMI-1785) LOW CYCLE FATIGUE TESTS ON BERYLLIUM REFLECTOR MATERIAL Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 May 1967. 8p. Dep. NTIS $4.00.

Results of tests on Be under strain cycling conditions similar to those found in Be reactor reflectors during startup are presented. Results are analyzed and presented in stress-strain plots and in a table listing strain ranges and cycles. (JRD)

1413 (WANL-TMI-1974) THEORY AND APPLICATION OF FRACTURE MECHANICS. DeSalvo, G. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [1969]. 57p. Dep. NTIS $6.00.

Various approaches to the brittle fracture problem are described to provide a brief review of the state of the art, and to serve as a primer in the use of a modern approach to the combined problems of selection of materials and design against brittle failure. Included is a generalized description of linear elastic fracture mechanics technology and a comprehensive review of the information required to apply this design concept. Example problems are included to illustrate the methods of designing against brittle fracture and for calculating allowable stresses. The basic information, procedures, and criteria are provided that are necessary for the materials and design engineers to properly coordinate material application and to design for the prevention of brittle fracture. (auth)

1414 (Y-1980) EFFECT OF MELT TEMPERATURE AND TIME MOLTEN UPON THE HARDENING RESPONSE OF URANIUM-0.75 WEIGHT PERCENT TITANIUM ALLOY PLATE. Hemperly, V. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 7 May 1975. Contract W-7405-eng-26. 12p. Dep. NTIS $4.00.

Uranium-0.75 weight percent titanium alloy ingots were prepared with different melt temperatures and times in the molten condition. The ingots were rolled, homogenized, solution treated, water quenched, and each aged at two different temperatures. Hardening response was measured by the yield strength-elongation relationship obtained in tensile tests. Increasing the melt temperature and melt time produced an increasing hardening response. (auth)

1415 TEXTURE STRENGTHENING AND STRENGTH DIFFERENTIAL IN ^{6}Ti–Al–4V. Lowden, M. A. W.; Hutchinson, W. B. (Univ. of Birmingham, Eng.). Met. Trans.; 6A: No. 3, 441-448 (Mar 1975).

The alloy Ti–6 Al–4 V was processed in the laboratory to develop a wide range of textures, and determinations were made of the yield loci for these conditions. Optical and electron metallography were used to gain information about the operative deformation modes under various states of stress. Only limited texture strengthening is observed for conditions of tensile loading, although quite significant effects are found in compression. In strongly textured material a large strength differential occurs along the c axis direction, but this cannot be attributed to twinning. It is shown that (c + a) slip can play a major role in plastic deformation, and that the observed mechanical properties result from the peculiar characteristics of the (c + a) dislocations. (auth)

1416 COMMENTS ON STAGE III ANNEALING KINETICS IN Mo. Evans, J. H. (Danish Atomic Energy Commission, Roskilde). Scr. Met.; 9: No. 2, 101-104(Feb 1975).

The analysis of recent results on the order of annealing kinetics in stage III in molybdenum after cold-work and neutron irradiation is incorrect and could lead to false conclusions. A different method of measuring the order of kinetics, gamma, shows that this parameter remains approximately 2 for the entire range of induced defect concentrations. (PMA)

1417 REPLY TO: COMMENTS ON STAGE III ANNEALING KINETICS IN Mo. Cornelis, J.; De Meester, P.; Goedeme, G.; Nihoul, J.; Stals, L. (CEN, Mol, Belgium). Scr. Met.; 9: No. 2, 105-107(Feb 1975).

The reaction order parameter, gamma, would be difficult to describe as a constant, because the reaction order is known to vary continuously from rather high values to a value in the vicinity of 2 or lower during a single recovery process occurring in one specimen. This behavior is entirely consistent with a mechanism involving diffusion-controlled bimolecular recovery. Evans' method, although correct in principle, is very sensitive to accidental errors, since the results are based on individual estimations of the temperature derivative of resistivity. The use of the method of Stals et al. remains justified. (PMA)

1418 EFFECT OF EXCESS ENTROPY ON THE ACTIVITY COEFFICIENT OF INDIUM IN ALPHA Cu–In ALLOYS. Masson, D. B.; Bhattacharya, D. (Washington State Univ., Pullman). Scr. Met.; 9: No. 2, 207-210(Feb 1975).

In work reported earlier, atomic absorption spectroscopy was used to measure the vapor pressure of indium over binary alloys of the alpha Cu–In system. The thermodynamic activity, partial molar enthalpy and partial molar entropy of indium were calculated from the vapor pressure and its temperature coefficient. An interesting result was that DELTA anti G/sub In//sup xs/ showed a minimum when plotted against atom fraction. This behavior has not been explained and is not predicted by solution models that have been suggested for this type of alloy. This note contains some calculations of nonconfigurational contributions to the excess entropy which suggest a cause for the occurrence of a minimum value of DELTA anti G/sub In//sup xs/. (PMA)

1419 EFFECTS OF Mo AND Al ON THE THERMAL EXPANSION COEFFICIENTS OF Ni-BASE ALLOYS. Morrow, H. III; Sponseller, D. L.; Semchyshen, M. (Climax Molybdenum Co., Ann Arbor, MI). Met. Trans.; 6A: No. 3, 477-485(Mar 1975).

The effects of Mo and Al on the mean linear thermal expansion coefficients from room temperature to 1050^{0}C were determined for two types of nickel-base alloys. The Solid Solution Alloys were cast and homogenized Ni–Co–Cr–Mo alloys with 0, 3½, and 6½ nominal wt percent Mo concentrations. The Gamma Prime Alloys were wrought and heat-treated Ni–Cr–Mo–Al(Ti) alloys with 0, 2, 5, and 8 nominal wt percent Mo in each of four Al plus Ti levels (3 percent Al, 4½ percent Al, 6 percent Al, or 1 percent Al + 3½ percent Ti nominal wt percent). Thermal expansion coefficients were determined on at least two specimens from each alloy. It was found that Mo lowers the thermal expansion coefficients of both the cast Ni–Co–Cr solid solutions and the wrought Ni–Cr–Al(Ti) two-phase alloys. Both aluminum and titanium were also observed to decrease expansion coefficients in the two-phase, gamma + gamma', alloys. Results are discussed in terms of relative melting point effects between solute and solvent elements, and in terms of the volume fraction of the gamma' phase present. (auth)

1420 EFFECT OF THERMAL EXPOSURE ON THE MECHANICAL PROPERTIES OF THE DIRECTIONALLY SOLIDIFIED SUPERALLOY TRW–NASA VIA. Collins, H. E. (TRW Inc., Cleveland). Met. Trans.; 6A: No. 3, 515-530(Mar 1975).

The nickel-base superalloy TRW–NASA VIA was studied in the directionally solidified (DS) condition utilizing metallographic and residue analysis techniques in conjunction with mechanical property tests to determine the effect of thermal exposure on the microstructure and mechanical properties. Exposure conditions of 1000 h at temperatures from 1500 to 1900^{0}F (816 to 1038^{0}C) were investigated. Four minor phases (two varieties of MC, M_6C and M_3B_2) plus gamma-prime were identified in the gamma matrix of the DS material. Significant variations were observed to occur in the mechanical properties with thermal exposure. Microstructural evaluation indicated that, as in the equiaxed condition, these variations were due principally to gamma-prime agglomeration or ripening. Comparison of the findings from the DS and the equiaxed process conditions indicated several factors which contributed to the property enhancement observed in the DS condition. These included: (1) the virtual elimination of the transverse grain boundaries by the DS process which improved the 1400 (760^{0}C) and 1800^{0}F (982^{0}C) properties; (2) the heterogeneous distribution of the blocky and the spherical-like gamma-prime which primarily improved the room temperature and the 1400^{0}F (760^{0}C) strength properties; (3) the generally larger gamma-prime size as well as the intragranular columnar form which improved the ductility properties; and (4) the longitudinal grain boundaries containing the stabilized Hf enriched MC and the M_6C carbides, which, in conjunction with the intergranular gamma-prime formation, also improved the ductility properties. (auth)

1421 ELECTROTRANSPORT AND DIFFUSION OF Fe AND Ag IN ALPHA–Y. Murphy, J. E. (Reno Metallurgy, Research Center, NV); Adams, G. H.; Cathey, W. N. Met. Trans.; 6A: No. 2, 343-348(Feb 1975).

The electrotransport mobilities and diffusion coefficients were determined for iron and silver impurities in yttrium. The mobility of iron increased from 1.2 x 10^{-4} cm^2/V-s at 900^{0}C to 7.4 x 10^{-4} cm^2/V-s at 1330^{0}C. The silver mobility ranged from 8.1 x 10^{-6} cm^2/V-s at 905^{0}C to 6.4 x 10^{-5} cm^2/V-s at 1095^{0}C. The iron movement was anode-directed, and the silver movement was cathode-directed. The diffusion coefficients obtained fit an Arrhenius equation D equals D_0e/sup -DELTA H/RT/ with the following values: Fe: D_0 equals 1.8 x 10^{-2} cm^2/s, DELTA H equals 85 kJ/mol (20 kcal/mol); Ag: D_0 equals 5.4 x 10^{-3} cm^2/s, DELTA H equals 77 kJ/mol (18 kcal/mol). A substitutional-interstitial mechanism previously proposed for anomalously high diffusion rates of impurities in cerium and lanthanum is also proposed for yttrium. (auth)

1422 FATIGUE FRACTURE OF CUBE ORIENTED Ni-BASE SUPERALLOY SINGLE CRYSTALS. Leverant, G. R.; Gell, M.

(Pratt and Whitney Aircraft, Middletown, CO). Met. Trans.; 6A: No. 2, 367-371(Feb 1975).

Carbon-free single crystals of Mar-M200 were tested in pulsating tension, stress-controlled fatigue at temperatures and frequencies ranging from 1033 to 1255°K and 0.033 to 1058 Hz, respectively. The axis of loading was parallel to (001), the natural growth direction for directionally-solidified nickel-base alloys. Except for the lowest frequency at the higher temperatures where creep damage was extensive, crack initiation occurred at subsurface microporosity. Cracks initiated and propagated in the Stage I mode (crystallographic cracking on the (111) slip planes) at the lower temperatures and higher frequencies, whereas Stage II (perpendicular to the principal stress axis) crack initiation and propagation was found at the higher temperatures and lower frequencies. Often a transition from Stage II to Stage I crack propagation was observed. It was established that Stage I cracking occurred under conditions of heterogeneous, planar slip and Stage II cracking under conditions of homogeneous, wavy slip. A thermally activated recovery process with an activation energy of 368 KJ/mole (88 Kcal/mole) determined the instantaneous slip character, i.e., wavy or planar, at the crack tip. In addition, it was found that an optimum frequency existed for maximizing fatigue life. At frequencies below the optimum, creep damage was detrimental, while at frequencies greater than the optimum, intense, planar slip was detrimental. The optimum frequency increased with increasing temperature. (auth)

1423 ISOTOPE EFFECT AND THE INFLUENCE OF INTERSTITIAL IMPURITIES ON THE H SOLUBILITY LIMIT IN Nb AND V. Westlake, D. G.; Ockers, S. T. (Argonne National Lab., IL). Met. Trans.; 6A: No. 2, 399-402(Feb 1975).

The solubility limits for hydrogen and deuterium in niobium were determined resistometrically between 175 and 280°K before and after purification of the niobium by ultra-high vacuum treatment. No isotope effect was observed; neither was an interstitial impurity effect detected in the low concentration range studied. The solubility limits for hydrogen in vanadium were measured at temperatures between 230 and 325°K before and after additions of oxygen greater than 1000 at. ppm. Large concentrations of solute oxygen increase the apparent solubility limit for hydrogen in vanadium. (auth)

1424 COMPARISON OF FIRST QUADRANT YIELD LOCI FOR Ti–6Al–4V WITH THOSE PREDICTED BY KNOOP HARDNESS MEASUREMENTS. Amateau, M. F.; Hanna, W. D. (Aerospace Corp., El Segundo, CA). Met. Trans.; 6A: No. 2, 417-419(Feb 1975).

Knoop hardness impressions were used to construct biaxial yield loci in Ti–6Al–4V for a variety of textures. These results were compared with partial yield loci in the first quadrant, determined from flow stress measurements at three stress ratios. In each case, the Knoop hardness technique was not sufficiently sensitive to predict the shape of the yield locus, the largest discrepancy occurring for the most anisotropic sample. (PMA)

1425 OXYGEN DISTRIBUTION IN INTERNALLY-OXIDIZED Ta–8 PERCENT W–2 PERCENT Hf ALLOY. Liu, C. T.; Carpenter, R. W.; Inouye, H. (Oak Ridge National Lab., TN). Met. Trans.; 6A: No. 2, 419-421(Feb 1975).

Sheet specimens of Ta–8W–2Hf, recrystallized for 1 h at 1823°K, were internally oxidized at an oxygen pressure of 1×10^{-5} torr at 1273 and 1523°K. The oxygen content and distribution were determined near the surface and nearer to the sample center by vacuum fusion analysis. The specimens oxidized at 1273°K showed only a small difference in oxygen content at the two thicknesses, but the 1523°K sample showed a large decrease in oxygen content near the center. The results can be understood on the basis that, at the higher temperature, most of the oxygen is trapped near the surface in large oxide precipitates instead of diffusing toward the center, remaining in solution. (PMA)

1426 DIFFUSIONAL HOMOGENIZATION BEHAVIOR IN FINITE Ni–Mo COUPLES. Lanam, R. D. (Olin Metals Research Lab., New Haven); Heckel, R. W. Met. Trans.; 6A: No. 2, 421-423(Feb 1975).

Ni–Mo couples were fabricated from foils by diffusion bonding at 950°C for 1 h (2500 psi) in a hydrogen atmosphere. Homogenization treatments were carried out at 1100°C (1 atm) and 1200°C (1000 psi). Phase layer thicknesses and concentrations were determined from quantitative metallography and electron microprobe techniques. The experimental values corresponded closely to values calculated from a previously described model based on Fick's Law and interface flux-balance equations. (PMA)

1427 STRUCTURAL CHANGES IN MOLYBDENUM DURING SHORT-TIME TENSILE AND HIGH-TEMPERATURE CREEP TESTS. Zasimchuk, E. E.; Zelenyuk, E. E.; Marusii, O. I. (Inst. of Problems of Strength of Materials, Kiev). Probl. Prochnosti; 6: No. 5, 601-604(May 1974).

Translated from Probl. Prochnosti; 6: No. 5, 76-79(May 1974).

Short-time tensile tests on as-received (hot-rolled) and annealed specimens show that their strength differs only below 1000 C, and are approximately the same at higher temperatures. Below 1000 C, the ultimate tensile strength of the as-received specimens was substantially higher than that of the annealed samples, due to the fact that no recrystallization takes place in the as-received material during the 15 minute holding period before loading. Creep tests were carried out on smooth and notched heat-treated samples and on specimens with protective coatings. The results show that the protective coatings do not produce any changes in the mechanism of the weakening of molybdenum in creep at elevated temperatures. (PMA)

1428 DISPERSION RELATIONS IN BERYLLIUM AND THALLIUM. Upadhyaya, J. C.; Sinha, H. P. (Agra Coll., India). Indian J. Pure Appl. Phys.; 13: No. 1, 26-30(Jan 1975).

Phonon dispersion in two simple metals (Be and Tl) has been studied on the basis of a phenomenological model which uses ion-ion interaction through 5-neighbor central pair potentials and ion-electron-ion interaction on the lines of modified Sharma-Joshi theory [J. Chem. Phys., 39 (1963), 2633]. Good agreement with the neutron data has been obtained along ΓA direction, while substantial discrepancies are present at the zone boundary point M. (auth)

1429 CREEP OF A NUMBER OF URANIUM ALLOYS IN THE GAMMA-STATE. Section I. Gonozov, L. I.; Makhova, V. A.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). pp 111-118 of Stroenie i Svoista Splavov Dlya Atomnoi Ehnergetiki. Razdel I. Moscow; Izdatel'stvo Nauka (1973).

An investigation was carried out of creep under tension and compression of alloys containing 85 at. % uranium in the gamma region of the systems U–Zr–Nb, U–Nb–Mo, U–Zr–Ti, and U–Nb–Ti (test temperatures of 760 to 880°C; stress of 1 to 2 kg/mm²). For the binary alloys the creep rate decreases in the order U–Zr, Ti, Nb, and Mo, which does not agree with the change in melting temperature of the alloys and in diffusion coefficients. It is shown by calculation that ϵ decreases exponentially with an increase of elastic distortions in the gamma-solid-solutions; in this case the hot hardness increases linearly. Within the limits of a single system the value of lg ϵ is directly proportional to lg D, where D is the coefficient of mutual diffusion. The creep activation energy Q_η is close to the activation energies of the mutual or self diffusion. In connection with the high concentration of vacancies near the grain boundaries the creep is controlled by sections strengthened by the piling up of dislocations at the grain boundaries; the sensitivity to stress is higher as a result of this behavior. An increase in deformation rate leads to an increase of the grain contribution to creep and to some increase of Q_η and η. As a result of the ready adaptation of grain boundaries, intergranular voids do not occur during creep. Dispersion strengthening of the grains decreases ϵ by 2 to 3 orders of magnitude; the value of η approaches 4. This strengthening in combination with alloying of the solid solution which assures a decrease in diffusion mobility is apparently the most effective method of improving the stability of gamma-alloys to gas swelling. (tr-SJR)

1430 INCREASE IN STRENGTH PROPERTIES OF STEEL 12 KhM WELDED JOINTS OF THICK-WALLED EQUIPMENT. Pechennikov, V. I.; Kroshkin, V. A.; Rubenchik, Yu. I.; Bronshtein, L. M. Svar. Proizv.; No. 5, 25-26(May 1974). (In Russian).

Results are presented on an investigation of the weldability and the effect of thermal treatment on the mechanical properties of welding alloys of the following systems: alloy 1 containing Ti–6 Al–6 Zr–6 V–2 Sn, and alloy 2 containing Ti–5 Al–4 Mo–5 Zr–1 Cu. The chemical composition of these alloys is presented. A study was made of the structure and properties of weld alloy samples 50 mm thick made by electroslag welding. The weld alloys were subjected to annealing in the temperature interval of 700 to 800°C at various holding times. It was established that an optimal mode of annealing was the following: heating to 800°C, holding for one hour and cooling in the furnace to 400°C at a rate of 4.5°C/min, and then cooling in air. As a result of this treatment the ductility of the weld metal and zone metal is increased to the ductility metal of the base metal. An investigation of the microstructure of samples subjected to annealing shows that in the weld metal and in the zone near the weld the annealing promotes a more complete breakdown of the α'- and β-phases. (tr-SJR)

1431 RADIOGRAPHIC INVESTIGATIONS OF THE STRUCTURE OF POWDERED TUNGSTEN TREATED WITH SUPERHIGH PRESSURES. Baturin, V. E.; Klebanov, Yu. D. (All-Union

Scientific-Research Inst. of Metallurgical Thermal Engineering, Sverdlovsk, USSR). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 81-85(Jan 1975). (In Russian).

A radiographic study was made of the effect of superhigh pressure (pressure to 60 kbar and temperature to 1200°C) on the structure of powdered tungsten. The average size of coherent scattering blocks (subgrains) and the microstresses were found as functions of the pressure and temperature. Subgrain enlargement due to the superhigh quasihydrostatic pressures was observed, and may be due to the motion of dislocations and their subsequent annihilation or exit onto the grain surfaces. (auth)

1432 MANGANESE–BORON SYSTEM. Pradelli, G.; Gianoglio, C. (Politecnico, Turin). Met. Ital.; 66: No. 12, 659-662 (Dec 1974). (In Italian).

The binary manganese-boron system has been investigated, up to 50% boron. In this region of the system three manganese borides are to be found, including the δ phase (Mn_4B), orthorhombic, which contains 20 to 33 at. % boron at 1050°C. This phase is stable up to 1124°C. The tetragonal Mn_2B compound (ϵ phase) contains 33.3 at. % boron. The orthorhombic MnB compound (ξ phase) has a composition that corresponds to 50 at. % boron content. The phases Mn and Mn_2B originate at 1211°C an eutectic, corresponding to a 14.3 at. % boron content. In the temperature range between 1124 and 1211°C the stable phases are manganese and ϵ (Mn_2B) phase. δ phase and Mn_2B do coexist only in an extremely narrow two-phase region of the system. (auth)

1433 MAXIMIZING CREEP DEFORMATION RESISTANCE. McElroy, R. J. (Surrey Univ., Guildford, Eng.); Ishida, Y.; Szkopiak, Z.; McLean, D. Metals Technology; 1: No. 10, 468-474(Oct 1974).

An attempt was made to maximize the creep deformation resistance of a precipitation hardening fcc iron alloy, 16Cr–25Ni–Nb, by using the accumulated knowledge relating creep to microstructure. It was decided that three structural criteria must be met and that multiple mechanical thermal treatment (mmtt) was the treatment most likely to meet them. The criteria and treatment results were: (1) a dislocation density not less than 1.5×10^7 mm/mm^3; that produced was 1.8×10^8 mm/mm^3; (2) a large fraction of the precipitate particles should lie on dislocations in order to anchor them; the result was 68%, and moreover precise examination with the 1 MV electron microscope showed that network growth occurred only at the rate allowed by particle coarsening; and (3) the dislocation network should be as uniform as possible; from about 40 measurements it was found that the standard deviation of the dislocation density, expressed as a percentage of the mean density, was 4.5 compared with 22 for ordinary cold work. Test results showed mmtt samples to have substantially greater creep deformation resistance than samples treated in other ways. The value of maximizing a structure sensitive property even by an expensive treatment like mmtt is that the results of commercial treatments can be compared with the upper bound, so determined, to see if there is worthwhile room for improvement. The ductility dropped sharply after mmtt, probably because the inherent cohesion of the particular alloy used is weak in relation to the high deformation resistance developed. (auth)

1434 LOCAL ELASTIC CONSTANTS IN DILUTE Mo–Re ALLOY. Kesharwani, K. M. (Allahabad Univ., India). Indian J. Pure Appl. Phys.; 12: No. 12, 811-814(Dec 1974).

The explicit expressions for the local elastic constants around impurity atom present in a monatomic body-centered cubic lattice were determined. A perturbation model which includes the change in mass at the impurity site and the changes in the central and non-central interactions between the impurity and its nearest neighbors, were employed. Numerical estimates are made in molybdenum-rhenium alloy. It is found that changes in the local elastic constants are significant and mainly dependent on the large change in the non-central force constant. (auth)

1435 EVIDENCE FOR THE EXISTENCE OF FAULTING IN A SPLAT-COOLED DELTA–Pu(Ti) ALLOY. Roof, R. B.; Elliott, R. O. (Los Alamos Scientific Lab., NM). J. Mater. Sci.; 10: No. 1, 101-108(Jan 1975).

Examination of x-ray diffraction profiles of a splat-cooled 15 Ti–85 Pu alloy has revealed that the material contains a large amount of twinning coupled with a reasonably small crystallite size and high strain. The localized strain is estimated to be 0.6%, the crystallite size ≈250 Å, and the twinning fault probability is large at 0.043. (auth)

1436 DIRECT OBSERVATION OF CARBON ATOM CLUSTERS IN HIGH PURITY MOLYBDENUM DOPED WITH CARBON. Yoshioka, K. (Tohoku Univ., Japan); Kimura, H. Scr. Met.; 9: No. 4, 361-366(Apr 1975).

Carbon atom clusters are formed during the first stage of resistivity recovery (near 250°C) in molybdenum-carbon alloys. In specimens of 470 at. ppm carbon, precipitates are formed during quenching. These precipitates are stable up to 600°C and are considered to be of different structure from the 250°C clusters. (auth)

1437 STRUCTURE OF AN AMORPHOUS SUPERCONDUCTOR, LANTHANUM-GOLD. Logan, J. (California Inst. of Tech., Pasadena). Scr. Met.; 9: No. 4, 379-382(Apr 1975).

A structural study was made of La–20 Au produced by rapid quenching from the liquid state. X-ray diffraction techniques gave a La–Au coordination number of 2.9, and a La–La coordination number of 8.1. The La–Au distance is, on the average, smaller than the La–La distance, and there are no Au–Au neighbors within 4.4 A. (PMA)

1438 SOLUTE DIFFUSION OF IRON IN THE LIGHT RARE-EARTH METALS CERIUM, PRASEODYMIUM, AND NEODYMIUM. Dariel, M. P. (Nuclear Research Centre-Negev, Beersheva, Israel). Acta Met.; 23: No. 4, 473-479(Apr 1975).

The thin layer sectioning technique has been used in order to determine the solute diffusivity of ^{59}Fe tracers in the light rare-earth metals cerium, praseodymium, and neodymium. The measurements were made both in the close-packed (fcc for Ce and double-hcp for Pr and Nd) and in the high-temperature bcc phases of the solvent metals. The diffusivities of iron are extremely high, with values exceeding 10^{-5} cm^2/sec at temperatures above 0.7 T/sub m/ (T/sub m/ melting temperature of the solvent metal). The activation energies are much lower than the activation energy for self-diffusion, of the order of 10 kcal/mole. The results indicate that iron is a fast-diffusing solute, its diffusion in the rare-earth metals taking place probably by means of the dissociative mechanism, with a predominantly interstitial component. Several simultaneous measurements of the diffusivity of ^{54}Mn suggest that Mn is also a fast-diffusing solute, though to a lesser extent than ^{59}Fe. (auth)

1439 DISPLACIVE TRANSFORMATIONS IN NEAR-EQUIATOMIC NIOBIUM–RUTHENIUM ALLOYS. I. Morphology and Crystallography. Das, B. K.; Lieberman, D. S. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Acta Met.; 23: No. 5, 579-585(May 1975).

Displacive phase transformations in near-equiatomic Nb–Ru alloys were studied using electrical resistivity measurements, optical metallography and X-ray diffraction. Alloys containing between 41 and 45 at. percent Ru undergo a CsCl (beta) to tetragonal (beta') transformation on cooling from 1500°C to room temperature. Alloys containing more than 46 at. percent Ru exhibit a two step CsCl (beta) to tetragonal (beta') to orthorhombic (beta'') transformation on cooling to room temperature. Although the product of each successive transformation consists of stacks of twins (in beta' yields beta'', twins within twins), the transformations do not proceed by the advance of sharp planar interfaces as in many of the first order martensitic transformations resulting in morphologically similar products. Rather, the interphase region consists of a small volume of the crystal over which the parent phase is gradually distorted into the product phase. (auth)

1440 FRAGMENTED TWINS IN Mo–35 AT. PERCENT Re ALLOY. Mahajan, S. (Bell Telephone Labs., Inc., Murray Hill, NJ). Acta Met.; 23: No. 5, 547-552(May 1975).

The crystallographic features of fragmented twins and associated substructures were correlated by transmission electron microscopy. In three out of the four cases examined, fragmented segments exhibit no lateral displacements with respect to each other, whereas in one situation, offset is observed in the absence of glide dislocations whose Burgers vector is not parallel to the twinning vector. In the majority of the cases, fragmentations are envisaged to be obstacle-induced, whereas the latter case is consistent with slip-induced fragmentation hypothesis. Further, in a few cases it has been possible to identify the obstacles, and the origin of these obstacles is considered. (auth)

1441 MAGNETIC PROPERTIES OF Gd/sub 1-x/Th/sub x/Fe_2 AND Gd/sub 1-x/Ce/sub x/Fe_2. Miskinis, E. T.; Narasimhan, K. S. V. L.; Wallace, W. E.; Craig, R. S. (Univ. of Pittsburgh). J. Solid State Chem.; 13: No. 4, 311-314(Apr 1975).

Saturation magnetization, magnetization vs temperature, Curie temperatures, and lattice parameters are presented for the ternary alloys Gd/sub 1-x/Th/sub x/Fe_2 and Gd/sub 1-x/Ce/sub x/Fe_2. Quadrivalent Th and Ce were introduced into the lattice in an effort to induce ferromagnetic Gd–Fe coupling. Experiment showed that the antiferromagnetic Gd–Fe coupling in $GdFe_2$ is preserved in the ternaries. The Fe moment and Curie temperature decrease as the Gd content of the sample is decreased. This is ascribed to electron transfer from Th or Ce to the Fe d shell. Failure to achieve ferromagnetic coupling is ascribed to electron capture by iron, which prevents a rise in electron concentration as Gd is replaced by Ce or Th. (auth)

1442 PHASE EQUILIBRIA IN THE TERMINAL REGIONS OF THE NEODYMIUM–GOLD SYSTEM. di Aldo Borsese, N.; Capelli, R.; Delfino, S.; Ferro, R. (Univ., Genoa). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 54: No. 6, 957-960 (Jun 1973). (In Italian).

Differential thermal analysis, chemical analysis, and metallographic and X-ray examinations were used for studying Nd–Au alloys. A comparison of the results obtained from thermoanalysis of heating pre-annealed samples or cooling them from the melt shows that, very often, slow rates of formation delay the equilibration of the solid phases. Following invariant equilibria were observed: (1) Eutectic: Liq(8.8 at.% Nd) $\rightleftharpoons$ Au + Au_6Nd (800° ± 5); (2) Peritectic: Liq(~ 11 at.% Nd) + Au_4Nd $\rightleftharpoons$ Au_6Nd (840° ± 5); (3) Peritectic: Liq(~ 13.5 at.% Nd) + $Au_{3.6}Nd$ $\rightleftharpoons$ Au_4Nd (898° ± 5); (4) Melting: $Au_{3.6}Nd$ (liq) $\rightleftharpoons$ $Au_{3.6}Nd$ (solid) (1230° ± 10); (5) Inverted melting: $Nd_\beta \rightleftharpoons Nd_\alpha$ + Liq (824° ± 5); (6) Eutectic: Liq (~ 81.5 at.% Nd) $\rightleftharpoons$ Nd_α + $AuNd_2$ (655° ± 5); and (7) Peritectic: Liq(~ 72.5 at.% Nd) + AuNd(?) $\rightleftharpoons$ $AuNd_2$ (760° ± 5). From a preliminary investigation of the 30–50 at.% alloys, it was observed that a large number of transformations and reactions occur in this composition field. (auth)

1443 STUDY OF THE SUPERCONDUCTING PROPERTIES OF THIN FILMS OF Nb_3Sn AND V_3Si IN MAGNETIC FIELDS. Dienwiebel, I. (Giessen Univ. (F. R. Germany). Inst. fuer Angewandte Physik). 29 Mar 1972. 66p. (In German). INIS.

Available from the library of the Giessen Univ.

Thin Nb_3Sn films having a thickness of about 250–1,500 A were prepared by the simultaneous evaporation of niobium and tin in UHV. These films were systematically investigated for their superconducting properties in a magnetic field up to 37 kOe. Measurements of the critical field strengths were in good agreement with the theory of Sain-James and deGennes. The angular behavior of the critical field of the superconducting thin films shows the dependence described by the Tinkham formula. A new type of behavior on the other hand, occurs in the surface superconducting region. H_1 is no longer the lowest critical field, instead a field H (60°). This field is to be regarded as the new H_2 critical field. The behavior agrees with the model of Tilly and Ward based on the theory of expanded flux lines of Kulik. (GE)

1444 QUANTITATIVE ESTIMATE OF THE NONLOCALITY IN THE ANIMALU–HEINE MODEL POTENTIAL. Shenoy, S. R.; Halder, N. C. (Univ. of South Florida, Tampa). Phys. Rev., B; 11: No. 2, 690-698(15 Jan 1975).

A criterion was developed for estimating the validity of the quasilocal approximation to the nonlocal-model-potential form factor. The weighting effect of the structure factor in momentum space is simulated by a cutoff procedure. For numerical calculation, the Animalu-Heine parameters for the Abarenkov-Heine model potential for a number of elements were considered. However, findings for the elements considered agree reasonably well with the behavior reported earlier in various theoretical and experimental investigations. (auth)

1445 PHASE DIAGRAM OF THE SYSTEM Nd–Ge. Eremenko, V. N.; Batalin, V. G.; Buyanov, Yu. I. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1188-1192(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1384-1388(Aug 1974).

The Nd–Ge phase diagram was constructed from microstructural, differential thermal, differential dilatometric, and x-ray phase analyses. The following phases were discovered: Nd_5Ge_3 (Mn_5Si_3 type), Nd_5Ge_4 (Sm_5Ge_4 type), NdGe (CrB type), and $NdGe_{2-x}$ with $x \sim 0.4$. The last phase has two polymorphic modifications: a high-temperature phase of the α-$ThSi_2$ type and a low-temperature one of the α-$GdSi_2$ type. The Nd_5Ge_4 and $NdGe_{2-x}$ phases melt congruently, whereas the Nd_5Ge_4 and NdGe phases are formed by peritectic reactions. (auth)

1446 PHASE DIAGRAM OF THE SYSTEM Ho–Te. Yarembash, E. I.; Vigileva, E. S.; Eliseev, A. A.; Zachatskaya, A. V.; Aminov, T. G.; Chernitsyna, M. A. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1212-1215(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1409-1413(Aug 1974).

The Ho–Te phase diagram was constructed. The compounds $Ho_{1-x}Te$, Ho_2Te_{5-x}, and $HoTe_{3-x}$ are formed in the system; $Ho_{1-x}Te$ crystallizes in the NaCl lattice and has a region of homogeneity from 50 to 55 at.% Te. The lattice constants of Ho_2Te_5 and $HoTe_3$ were determined. (auth)

1447 REACTIONS BETWEEN COMPONENTS OF THE SYSTEMS Cd–Sb AND Zn–Sb IN THE LIQUID STATE. Chizhevskaya, S. N.; Danil'chenko, V. A.; Kurbatov, V. P. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 8, 1201-1204(Aug 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 8, 1397-1400(Aug 1974).

The viscosity and electrical conductivity of melts of the systems Cd–Sb and Zn–Sb were investigated in the composition range 50 to 60 at.% Sb. An anomalous increase was found in the viscosity of the melts at ~600 and ~700°C in the composition range of the compounds CdSb and ZnSb, respectively. From an analysis of the viscosity and conductivity isotherms, conclusions are drawn concerning the thermal stability of $A^{II}Sb$, $A_4^{II}Sb_3$, and $A_3^{II}Sb_2$ compounds in the melt (where A is Zn or Cd). (auth)

1448 PHASE DIAGRAM OF THE SYSTEM NEODYMIUM–GADOLINIUM. Svechnikov, V. M.; Kobzenko, G. F.; Martinchuk, E. L. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 1, 79-83(Jan 1975). (In Ukrainian).

Cast and annealed alloys were studied by differential thermal, x-ray structural, and metallographic analyses. The phase diagram was plotted for the complete temperature and concentration range. The dependence of the specific electric resistance on their composition is established. (auth)

1449 RELATIONS BETWEEN THE STRUCTURE AND THE PROPERTIES OF Cr–Mo FERRITIC STEEL FOR STEAM-PIPINGS. Rinaldi, F.; Valente, G. Met. Ital.; 67: No. 1, 9-17 (Jan 1975). (In Italian).

After a critical review of the microstructural evolution of Cr–Mo ferritic steels at working or at laboratory testing conditions, some news is reported on a research program under way with long-term creep tests to be run. Based on research up to now on original materials, submitted to two standard heat treatments for steam ducts, and on creep-test results up to now, considerations on the influence of the microstructure on the original strength are expounded as well as on the "latent" one of the 2¼% Cr–1% Mo steel. The metallurgical transformations are analyzed by pointing out possible mechanisms and comparing the microstructural features with these of a 1% Cr–0.5% Mo steel. Behavior at high temperatures seems to be connected more to the interaction of many factors, among which are the microstructural kind and others depending on service conditions than the influence of the structure and their modifications alone. (auth)

1450 PHASE OF THE IRON–MANGANESE–BORON SYSTEM. Pradelli, G.; Gianoglio, C. (Inst. of General and Applied Chemistry, Turin). Met. Ital.; 67: No. 1, 21-23(Jan 1975). (In Italian).

A new phase consisting of a solid cubic solution of the type $(Fe, Mn)_{23}B_6$ was ascertained. The existence field and reticular constants thereof were determined according to temperature and composition. (auth)

1451 THERMO-EMFs OF ALLOYS OF THE INDIUM–TIN SYSTEM. Yatsenko, S. P.; Golovin, O. P. High Temp. (USSR) (Engl. Transl.); 12: No. 3, 586-587(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 673-675 (1974).

The integral thermo-emf was measured using a differential method for In–Sn alloys with 10, 20, 30, 40, 50, 60, 70, 75, 90 and 100 at.% Sn. The thermo-emf was a linearly increasing function of the temperature for the pure metals and for alloys containing 10-30 at.% In over the range 300-700 C. The same was true for other alloys from 300-600 C, but, above 600C, alloys with 10-60 at.% Sn behaved nonlinearly. (PMA)

1452 SPEED OF ULTRASOUND AND COMPRESSIBILITY OF BINARY BISMUTH–INDIUM ALLOYS. Magomedov, A. M. A.; Omarov, A. M. (Dagestan State Univ., Makhachkala, USSR). High Temp. (USSR) (Engl. Transl.); 12: No. 3, 572-573(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 661-662 (1974).

The speed of ultrasound was measured in Bi–In alloys through the solid to liquid phase transition region, and the adiabatic compressibility was found for the liquid and solid phases. The sharp discontinuity in the speed of sound occurring at the melting point is discussed. The composition/compressibility curve was found not to obey the additivity rule. (PMA)

1453 NEUTRON STUDY OF THE BETA-TO-OMEGA INSTABILITY IN $Zr_{0.80}Nb_{0.20}$. Moss, S. C. (Univ. of Houston, TX); Keating, D. T.; Axe, J. D. pp 179-188 of Phase Transitions, 1973. Henisch, H. K.; Roy, R. (ed.). New York; Pergamon Press (23 May 1973).

From meeting on applications of phase transitions in materials science; University Park, PA (23 May 1973).

Neutron scattering from a single crystal of Zr–20 percent Nb,

quenched from the bcc field, reveals both bcc Bragg peaks and intense diffuse scattering in the vicinity of the reciprocal lattice (rel) points of the trigonal omega (omega) phase. Neutron measurements revealed the omega diffuse scattering to have a strong elastic component. Phonon linewidths are wavevector dependent and away from the zone center are too broad to be observed. Results are discussed in terms of the dynamics of the phase transition and are qualitatively related to the lattice dynamics of the transition metals. (auth)

1454 MAGNETIC PROPERTIES OF Ln/sub 2-x/Ln'/sub x/Co_{17} COMPOUNDS (Ln EQUALS Gd, Dy, Ho, OR Er, Ln' EQUALS Th OR Ce). Narasimhan, K. S. V. L.; Wallace, W. E. (Univ. of Pittsburgh). J. Solid State Chem.; 13: No. 4, 315-318(Apr 1975).

Magnetic and structural characteristics of the ternary systems Ln/sub 2-x/Th/sub x/Co_{17} (Ln equals Gd, Dy, Ho, and Er) and Ln/sub 2-x/Ce/sub x/Co_{17} (Ln equals Gd, Dy, and Ho) are presented. Incorporation of Th in the lattice stabilizes the Th_2Zn_{17} structure, whereas incorporation of Ce does not; if the binary system has the Th_2Ni_{17} structure the incorporation of Ce leaves the structure unchanged. The antiferromagnetic Ln–Co coupling observed in the Ln_2Co_{17} systems persists in the ternary alloys. The moment of the cobalt sublattice is decreased when more than half of the Ln is replaced by Th, suggesting that the extra electron contributed by Th enters the Co d-band or d-shell. The direction of easy magnetization is in the basal plane for all composition in the Gd, Dy, and Ho systems. In Er/sub 2-x/Th/sub x/Co_{17} the easy direction is along the c-axis for x equals 0 and 0.2, but is in the basal plane for higher thorium contents. (auth)

1455 TRANSMISSION ELECTRON MICROSCOPY EVIDENCE FOR DISLOCATION DISSOCIATION AND STACKING FAULTS IN NIOBIUM. Chang, C. P.; Chen, C. W. (Ameb Lab., IA). Scr. Met.; 9: No. 4, 349-356(Apr 1975).

New transmission electron microscopy evidence is presented for the dissociation of screw dislocations in Nb and for stacking faults enclosed in the dissociated dislocations. A weak-beam dark-field technique played an essential role in the attainment of the evidence. Despite the dissolution of moderate amounts of interstitial impurities in the foil matrix, screw dislocations are seen to display high mobility at temperatures above 20°C and a strong tendency to dissociate. The observed dislocation mobility, coupled with the reversibility of the slip traces, suggests that the present material involves little, if any, segregation of interstitial impurities in the stacking faults. (auth)

1456 SNOEK PINNING OF DISLOCATIONS IN HIGH PURITY NIOBIUM. Quist, O. P.; Carpenter, S. H. (Univ. of Denver). Acta Met.; 23: No. 3, 321-328(Mar 1975).

Dislocation-interstitial interactions in two purity grades of high-purity niobium rod were studied by measuring the dislocation damping as functions of time, temperature, strain amplitude, and applied stress. Data were obtained using a composite Marx oscillator with resonant frequency of 50 kHz. Both grades of material exhibited a decrease in dislocation damping in the 0 to 60°C temperature range. The observed damping decrease is attributed to the pinning of dislocations by Snoek ordering of oxygen interstitial atoms in the strain field of the dislocation line segments. An expression was developed of the form delta(t,T) - $delta_0$ equals (delta/sub m/ - $delta_0$) exp [- (t/tau_0)/sup 1/3/ exp - (Q/3RT)] which relates the dislocation damping behavior to the time and temperature dependence of the Snoek ordering, where delta(t,T) is the dislocation damping, $delta_0$ and delta/sub m/ are the values of the damping at large and zero times respectively, t is the time, tau_0 is a constant, Q is the activation energy for the diffusional process, and RT has its usual meaning. The relation was shown to be consistent with the obtained data. (10 fig.) (auth)

1457 SPECIAL STEELS FOR NUCLEAR POWER. Vieillard-Baron, B. Trans. Amer. Nucl. Soc.; 20: 79-81(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1458 SPECIAL STAINLESS STEELS FOR THE NUCLEAR INDUSTRY. Leroy, F.; Amzallag, C.; Rabbe, P. Trans. Amer. Nucl. Soc.; 20: 81-82(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1459 CREEP PERFORMANCE AND UTILIZATION PROPERTIES OF SOME STEELS EMPLOYED IN THE NUCLEAR INDUSTRY. Mathern, G.; Decroix, J.; Lefevre, J.; Tricot, R. Trans. Amer. Nucl. Soc.; 20: 94-96(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1460 HYDROGEN AND TRITIUM PERMEATION THROUGH HELIUM-HEATED TUBE WALLS. Blumensaat, J.; Roehrig, H. D. (Kernforschungsanlage, Juelich, Ger.). Trans. Amer. Nucl. Soc.; 20: 728-730(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1461 ELECTRONIC TRANSPORT PROPERTIES AND SUPERSTRUCTURE IN THE TERNARY SYSTEM SILVER–MAGNESIUM–INDIUM. Bartsch, R.; Weiss, A. (Technische Univ. Darmstadt (F. R. Germany). Physikalische Chemie 3). Z. Metallk.; 66: No. 1, 39-46(Jan 1975).

The specific electrical resistivity rho and the Hall coefficient R of the β'-phase alloys of the ternary intermetallic system Ag–Mg–In were determined in the range $2\ K \leq T \leq 295\ K$. The alloys show a disorder-order transition from B2-type structure at low indium concentration to $L2_1$-type structure at high indium concentration. The measurements of R and rho as a function of temperature and valence electron concentration, VEC, are discussed within the frame of the two band model. The concentration of neck and belly electrons per atom and the ratio of the relaxation times for the electron-impurity scattering are determined. The transition from the B2 structure to the $L2_1$ structure is indicated by a characteristic change of these parameters of the two band model. The effects of the VEC and of annealing on R are discussed. The alloys with $L2_1$ structure and positive Hall coefficient show superconductivity. (auth)

1462 NMR AND MAGNETIC SUSCEPTIBILITY OF $CeCu_6$. Pop, I.; Codea, M.; Niculescu, V. (Univ., Cluj). Czech. J. Phys.; B24: No. 12, 1398-1405(1974).

NMR and magnetic susceptibility of $CeCu_6$ intermetallic compound were investigated. The most important contributions to the magnetic susceptibility are the Curie-Weiss term, expressing the paramagnetism of the localized f-electrons, and a temperature independent term for which all the contributions were estimated. The phenomenological exchange constant J_{sf} between 4f–electron spins and conduction–electron spins is derived to be –0.012 eV. The Knight shift and Curie temperature are discussed in terms of the Ruderman-Kittel-Kasuya-Yosida theory and in the Rocher's virtual bound states model. The s–f exchange integral Γ and the Fermi wave vector k_F are derived to be –0.8 eV and 1.32 $Å^{-1}$, respectively. (auth)

1463 DOUBLE PRISMATIC SLIP IN TEXTURED Mg–2% Be ALLOY. Saxl, I.; Haslingerova, I. (Nuclear Research Inst., Rez, Czechosl.). Czech. J. Phys.; B24: No. 12, 1351-1361(1974).

The tensile deformation of extruded and annealed rods of Mg–2% Be powder alloy is interpreted with respect to the observed fiber texture as a double prismatic slip with resulting elongation along the rod axis. Temperature and the strain-rate dependences of CRSS confirm that cross-slip is the controlling process at higher temperatures. The preferred orientation facilitates independent deformation of neighboring grains up to the fracture. (auth)

1464 RESISTIVITY RELAXATION FOR THE NIOBIUM–HYDROGEN SYSTEM. Schnabel, D. (Kernforschungsanlage, Juelich, Ger.); Alefeld, G. Collect. Phenomena; 2: No. 1, 29-35(Jan 1975).

By a new resistivity relaxation method, equilibrium properties of hydrogen in metals can be determined in temperature ranges, in which, due to surface problems, solubility measurements often are difficult. Furthermore the diffusion coefficient is measured by this technique. The applicability of the method is demonstrated for the system Nb–H. The measurements were performed over wide ranges of temperature ($300 \leq T \leq 600$ K) and concentrations ($10 \leq c \leq 55\%$ H/Nb) above the critical point. The derivative of the chemical potential $\delta\mu/\delta c$ is determined absolutely. Extrapolation to $\delta\mu/\delta c = 0$ yields the stability curve. The diffusion constant shows "critical slowing down" whereas for the mobility no anomaly is detectable in the region of the critical point. The decrease of the mobility with increasing concentration is mainly a consequence of the reduction of the number of free interstitial sites with increasing hydrogen concentration. (auth)

1465 STUDY OF THE SORPTION OF HYDROGEN ON SINGLE CRYSTALS OF TANTALUM BY MEANS OF LOADING CURVES. Kudryashov, I. V.; Makolkin, I. A.; Kopalin, N. G. (Moscow Inst. of National Economy). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 3, 400-402(1975). (In Russian).

By means of potential-time curves, the sorption of hydrogen on Ta electrodes in H_2SO_4 solutions was determined. The amount of hydrogen sorbed on the electrode depends on the crystallographic orientation of its surface. The sorption heats, determined by different methods, also depend on the crystallographic orientation. The mechanism of the interaction of hydrogen with Ta is probably different at temperatures from 10 to 30° and from 30 to 60°C. (tr-auth)

1466 AUTOMATIC TECHNIQUE FOR THE MEASUREMENT OF THERMOELECTRIC POWER AT HIGH PRESSURE. Ramesh,

T. G.; Reshamwala, A. S.; Srivatsa, M. T. (National Aeronautical Lab., Bangalore, India). Pramana; 3: No. 6, 377-382(Dec 1974).

An automatic technique is described for direct recording of the thermoelectric power of metals either as a function of temperature or pressure. This technique facilitates the process of measurement especially when one has to scan a wide temperature and pressure range. Typical experimental recordings of the γ-a electronic phase transition in cerium are also presented. (auth)

1467 STUDY ON THE RELAXATION PEAKS DUE TO THE STAGE 1 DEFECTS IN NEUTRON IRRADIATED MOLYBDENUM. Okuda, S.; Mizubayashi, H. (Japan Atomic Energy Research Inst., Ibaraki). Cryst. Lattice Defects; 4: No. 2, 75-82(1973).

From ninth international congress of crystallography; Kyoto, Japan (30 Aug 1972).

The internal friction and dynamic modulus measurements on zone refined Mo single crystals after fast neutron irradiation at low temperature revealed two relaxation peaks at about 11 and 39°K for measuring frequency of 500 Hz. The main features of these two peaks were: (a) the peak heights were proportional to the irradiation dose, (b) the peak widths were a little broader than that of a single relaxation, (c) the relaxation strengths depended on the crystal directions, both peaks having appeared larger in ⟨100⟩ than in ⟨111⟩ strain directions, and (d) the 11 and 39°K peaks recovered during annealing at the substages centered at 28 and 42°K, respectively, in stage I of electrical resistivity recovery. These two peaks were concluded to be associated with the interstitials of the stage I defects in Mo. Both of these interstitials had a maximum strain field along ⟨110⟩ crystalline direction and made a stress-induced rotational motion after an externally applied stress. (auth)

1468 SURFACE REACTIVITY OF TUNGSTEN. Gasser, R. P. H.; Jackson, G. V. (Oxford Univ). Nature (London); 253: No. 5491, 407-410(6 Feb 1975).

It is found that pre-adsorbed nitrogen or β-carbon monoxide inhibits the surface reactivity of tungsten towards hydrogen, both in catalysis and in adsorption. The effect of nitrogen can be satisfactorily accounted for by a simple reduction in the area of reactive filament, taking into account the selective adsorption of this gas by the low index planes of tungsten. With carbon monoxide the effect is considerably greater, perhaps because of lateral interactions between adsorbed hydrogen and carbon monoxide. (auth)

1469 EFFECT OF ALLOYING ELEMENTS ON TEMPERATURE OF TITANIUM POLYMORPHOUS TRANSFORMATION. Samsonov, G. V.; Braun, S. M.; Mal'ko, P. I. (Kherson State Pedagogical Inst., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 3, 273-276(Mar 1975). (In Ukrainian).

The effect of alloying elements V, Nb, Ta, Mo, Cu, Ni, and Al on the temperature of titanium polymorphous transformation is studied. The influence is analyzed in terms of electronic structure of the interacting components. (auth)

1470 PHASE DIAGRAM OF THE SYSTEM NEODYMIUM–SAMARIUM. Kobzenko, G. F.; Martynchuk, E. L. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 3, 263-266(Mar 1975). (In Ukrainian).

Cast and annealed alloys are studied by the methods of thermal, x-ray diffraction, and metallographic analyses. The alloys microhardness is measured. The phase diagram is plotted within a complete interval of concentrations. (auth)

1471 LOW-ENERGY ELECTRON DIFFRACTION STUDY OF OXYGEN ADSORPTION ON TUNGSTEN (110). Buchholz, J. C. Madison, WI; Univ. of Wisconsin (1974). 236p. University Microfilms Order No. 75-2451.

Thesis (Ph. D.).

Low-energy electron diffraction is used to study the structure, vibrational properties, and ordering properties of the p(2 x 1) structure of oxygen adsorbed on tungsten. Averaging of intensity profiles at constant momentum transfer is used in the structure analysis to extract the kinematic intensity. The temperature dependence of the intensity and the angular profiles of the diffraction beams is used to study both the vibrational properties of the surface and an order-disorder transition occurring in the adsorbed layer. From the average data it is concluded that the clean tungsten surface is relaxed less than 3 percent from its normal position. The mean square vibrational amplitude normal to the surface is found to be about twice as large as for a bulk atom. The surface structure for adsorbed oxygen is found to involve no reconstruction of the tungsten substrate. Possible positions for the oxygen atom in the overlayer are considered using the averaged data. The adsorbed oxygen atom is found to have a smaller mean square vibrational amplitude than a first plane tungsten atom. The disordering of the oxygen overlayer is studied in terms of several simple models to explore the lateral interactions within the surface. (Diss. Abstr. Int., B)

1472 MICROWAVE SURFACE RESISTANCE OF SUPERCONDUCTING NIOBIUM. Segal, H. R. New Brunswick, NJ; Rutgers–The State Univ. (1974). 113p. University Microfilms Order No. 75-8441.

Thesis (Ph. D.).

The microwave surface resistance of superconducting niobium has been investigated in magnetic fields up to H/sub c3/. Niobium samples with low tantalum concentration were outgassed in an ultrahigh vacuum at temperatures above 1800°C. The effect of various heat treatments and surface preparations have been studied. The surface resistance was measured as a function of external magnetic field and temperature in three orientations of magnetic field with respect to microwave current and sample surface. As had been expected from earlier work, the Caroli and Maki theory of oscillations of the order parameter for a clean type II superconductor did not agree with the experimental results, even for the highest quality sample used. The surface resistance measurements of the samples with short mean free paths were compared with various dirty limit theories. The results were in qualitative agreement only with those theories that contained additional terms in the response function other than those considered by Caroli and Maki. These results imply that extra terms should be added to the theoretical calculation of the surface resistance of a clean type II superconductor. Several simple models were constructed to explain the variation of the surface resistance with field from slightly below H/sub c2/ to H/sub c3/ and to explain the temperature variation of the surface resistance. Hysteresis in the surface resistance was studied in order to analyze the surface condition of the niobium. Preliminary results show that there is a thin, superconducting oxide on the surface of the niobium. (Diss. Abstr. Int., B)

1473 IRON-NICKEL-TITANIUM ALLOY WITH OUTSTANDING TOUGHNESS AT CRYOGENIC TEMPERATURE. Jin, S.; Morris, J. W. Jr.; Zackay, V. F. (Univ. of California, Berkeley). pp 379-384 of Advances in Cryogenic Engineering. Vol. 19. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corporation (1974).

Tensile properties, impact toughness, and fracture toughness were measured at 6 and 77°K for Fe–12 Ni–0.25 Ti with various heat treatments and compared with those of Type 304 stainless steel and Fe–9 Ni–1 Mn–0.1 C. (DLC)

1474 PROPERTIES OF SPUTTERED HIGH T/sub c/ THIN FILMS. Gavaler, J. R. (Westinghouse Research Labs., Pittsburgh). J. Vac. Sci. Technol.; 12: No. 1, 103-106(1975).

Of all of the presently known superconducting materials, only a few have critical temperatures (T/sub c/) of 15°K or higher. The properties of sputtered thin films of several of these highest T/sub c/ materials, including Nb_3Ge, NbN, Mo–Re, Nb–Sn, and Nb–Ga were investigated. It was found that these films occasionally have enhanced T/sub c/ compared to bulk samples. Most notable of these are Nb_3Ge films which have the highest presently known T/sub c/ (approximately 23°K). In addition, the sputtered films often exhibit superior current and magnetic field characteristics. All of these thin film results are reviewed together with x-ray and electron microscope results, which indicate that the enhanced properties of the films are due to both structural and compositional differences between thin film and bulk samples. (auth)

1475 SUPERCONDUCTING TRANSITION TEMPERATURE OF REACTIVELY SPUTTERED FILMS OF TANTALUM NITRIDE AND TUNGSTEN NITRIDE. Kilbane, F. M.; Habig, P. S. (Armco Steel Corp., Middletown, OH). J. Vac. Sci. Technol.; 12: No. 1, 107-109(1975).

Superconducting tantalum nitride and tungsten nitride films were prepared by reactively sputtering the pure metals in argon–nitrogen gas mixtures. X-ray diffraction and Auger electron spectroscopy were used to characterize the deposited compounds. For fcc TaN, a maximum T/sub c/ of 8.15°K was measured. The high T/sub c/ is attributed to achieving a nitrogen content close to the stoichiometric composition. In the tungsten–nitrogen system, a mononitride was not produced. However, superconductivity was found for films in the 5–20 at. percent nitrogen range. The maximum T/sub c/ of 4.85°K occurred in a compound close to the phase boundary between beta-W and W_2N. (auth)

1476 FIELD DESORPTION OF HELIUM AND NEON FROM TUNGSTEN AND IRIDIUM. Panitz, J. A. (Sandia Labs., Albuquerque, NM). J. Vac. Sci. Technol.; 12: No. 1, 210-212(1975).

The first complete crystallographic distribution of helium and neon field adsorbed on tungsten and iridium surfaces was deter-

mined using field desorption mass spectrometry. At 80°K, He^+ is removed from tungsten at high work function areas. The absence of He^+ in other regions indicates that either helium is not adsorbed, or that it is removed from the surface as a WHe^{3+} molecular ion during field evaporation of the substrate which is required for He^+ detection. Helium adsorbed on iridium at 80°K may form $IrHe^{3+}$ and neon $IrNe^{2+}$ near prominent zone lines. The absence of ion species in specific crystallographic regions of iridium and tungsten suggests care when interpreting atom probe results in certain metallurgical applications. (auth)

1477 ANGULAR-RESOLVED SECONDARY-ELECTRON—EMISSION SPECTRA FROM TUNGSTEN SURFACES. Willis, R.F. (Surface Physics Group, Astronomy Division, European Space Research Organisation, Noordwijk, Holland). Phys. Rev. Lett. 34: No. 11, 670-674 (17 Mar 1975).

Energy-distribution spectra have been measured for secondary electrons backscattered into a narrow angle about the normal direction to three tungsten-single-crystal faces, viz. (100), (110), and (111). Improved spectral resolution provides evidence for emission from excited states located above the vacuum level, the intensity of emission being related to one-dimensional density-of-states features along the corresponding low-index symmetry lines. Good agreement with a calculated energy-band structure is observed. (auth)

1478 STRUCTURAL TRANSFORMATION OF NEAR-EQUIATOMIC V-Ru COMPOUNDS AT HIGH PRESSURE. Chu, C.W.; Huang, S. (Department of Physics, Cleveland State University, Cleveland, Ohio 44115); Smith, T.F.; Corenzwit, E. Phys. Rev. B 11: No. 5, 1866-1869 (1 Mar 1975).

The structural transformation of near-equiatomic V-Ru compounds has been studied resistively under hydrostatic pressure up to ~21 kbar. It is found to be suppressed by the application of pressure. The rate of suppression increases as the Ru content approaches the critical concentration for the occurrence of the transformation. A critical pressure of 14 ± 2 kbar is obtained for the stabilization of the cubic phase down to 0 K in a sample containing 46-at.% Ru. The results are interpreted as support for the suggestion that the enhanced superconductivity in this compound system is associated predominantly with the singular feature of its electron energy spectrum. (auth)

1479 INFLUENCE OF ELECTRONS-PER-ATOM RATIO AND PHONON FREQUENCIES ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF LEAD ALLOYS. Dynes, R.C.; Rowell, J.M. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 5, 1884-1894 (1 Mar 1975).

The dependence of the superconducting transition temperature T_c of binary and ternary alloys in the Tl-Pb-Bi family on the electron-per-atom ratio s and on the average phonon frequencies has been determined using electron tunneling. These alloys exhibit a variation from weak (T_c=2.3 K) to strong (T_c=8.95 K) coupling behavior as s increases from 3 to 4.35. Over a substantial range of this variation the crystal structure remains fcc and it is found that T_c is a monotonic function of s in this phase. This is attributed to the increase in electron concentration, rather than to the decrease in phonon frequencies that was inferred from earlier neutron scattering measurements. In fact it is found that, although the electron-phonon coupling strength changes quite substantially throughout this series (λ from 0.8 to 2.1), the phonon spectrum $F(\omega)$ does not vary appreciably and the average phonon energies remain relatively constant. We point out that the "softening" of the lattice observed by neutron scattering has only a small effect on the total phonon spectrum. Our data serve as a critical test for the various calculations of the electron-phonon interaction and superconducting parameters. Good agreement with the extensive free-electron calculations for λ is obtained. The McMillan equation for T_c works well throughout this series with the largest deviations occurring at highest λ, beyond the region considered by McMillan. It is found that the product $N(0)\langle \mathcal{I} \rangle$, which is approximately constant for the fcc transition elements, is not constant in this case and we question whether this assumption should be applied indiscriminately. For simple metals McMillan suggested that a better choice of constant would be $\lambda\langle\omega^2\rangle/\Omega_p^2$, where Ω_p is the ionic plasma frequency, and for this alloy series we note that this appears to be more closely obeyed. Hence we derive an alternative "maximum T_c expression" by assuming that the phonon frequencies are fixed but that the electron density can be increased indefinitely. This expression agrees particularly well with experiment at smaller values of λ. Finally, we use the data to test the relationships between λ and the phonon energy renormalization $\Omega^2-\omega^2$ and it is found that quite good agreement can be achieved in this case. (auth)

1480 SUPERCONDUCTIVITY AND PHONON SOFTENING: II. LEAD ALLOYS. Allen, P.B. (Physics Department, State University of New York, Stony Brook, New York 11790); Dynes, R.C. Phys. Rev. B 11: No. 5, 1895-1905 (1 Mar 1975).

The electron-phonon coupling parameter λ is investigated theoretically for alloys of Pb with Tl and Bi. Experiments reported in a preceding paper show that McMillan's suggestion $\lambda \propto \langle \omega^2 \rangle^{-1}$ fails for these metals, indicating that the electronic factors $N(0)\langle \mathcal{I}^2 \rangle$ are playing an important role. On general grounds it is expected that the electronic coupling strength $N(0)\langle \mathcal{I}^2 \rangle$ is related to the amount of phonon renormalization $\Omega^2_Q-\omega^2_Q$, where Ω_Q is a bare phonon frequency. Thus, in spite of the failure of McMillan's suggestion, we conjecture that a formula exists which relates λ only to phonon frequencies; for nontransition metals we argue that this formula has the form $\lambda = (1/N)\sum_Q(\Omega^2_Q-\omega^2_Q)/\omega^2_Q$. Microscopic theory indicates that the bare frequency Ω_Q must include not only the Coulombic point-ion repulsion, but also the restoring force on a displaced point-ion due to the rigid-cyrstal charge density. Pseudopotential theory is used to estimate Ω^2_Q and $\bar{f}$ for lead alloys. The actual phonon frequencies ω_Q are known from inelastic neutron scattering and Born–von Karman extrapolation. Values of λ are calculated and compared with the tunneling results reported in the preceding paper. It is found that excellent agreement is obtained throughout the series if f is chosen to be 0.023, independent of material. It is hoped that this relation between λ and measured ω_Q bypasses the need for detailed knowledge of the electronic nature of the material and all that information is disguised in the difference $\Omega^2_Q-\omega^2_Q$. The extension of this work, however, to "nonpseudopotential" materials such as Nb or Nb_3Sn will require confronting the problem of identifying and calculating the "bare" frequencies Ω_Q. (auth)

1481 QUANTUM-RESISTANCE STATES OF SUPERCONDUCTING Pb FILMS. Hayler, L.G.; Geppert, L.M.; Chen, J.T.; Kim, Y.W. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev. B 11: No. 5, 1924-1934 (1 Mar 1975).

We found that the *I-V* curves of a Pb film in a parallel magnetic field may consist of several linear current branches, characterized by a set of quantized resistances proportional to $n-\alpha$, where n is an integer and α is a field-dependent constant parameter between 0 and 1/2. The film thickness t and the parallel magnetic field $H_\parallel$ required for observing these quantum-resistance states are $\xi < t < 3\xi$ and $H_{c2} < H_\parallel < H_{c3}$, respectively. A simple phenomenological model based on the assumption that the film has a superconducting-normal-superconducting layer structure has been presented with the interpretation of the quantum resistances in terms of the momentum quantization of bound quasiparticles. Our data indicate that if the interpretation based on the bound quasiparticles is correct, then the quantum resistances we have observed are those with $\hbar k_{zF} \ll (2m\Delta)^{1/2}$, where k_{zF} is the component of the Fermi momentum perpendicular to the film surface. (auth)

1482 SPIN-ORBIT INTERACTION AND QUENCHED ORBITAL ANGULAR MOMENTUM IN V_3Si. Fung, H.K.; Williamson, S.J.; Ting, C.S. (Department of Physics, New York University, New York, New York 10003); Sarachik, M.P. Phys. Rev. B 11: No. 5, 2053-2055 (1 Mar 1975).

The martensitic transformation temperature for a single crystal of V_3Si in a high magnetic field has been determined as a function of field orientation. Interpretation of the results establishes limits on the magnitude of the spin-orbit interaction and indicates that the orbital angular momentum of the *d* electrons is quenched. (auth)

1483 DIFFUSION IN COPPER AND COPPER ALLOYS. PART III. DIFFUSION IN SYSTEMS INVOLVING ELEMENTS OF THE GROUPS IA, IIA, IIIB, IVB, VB, VIB, AND VIIB. Butrymowicz, D.B.; Manning, J.R.; Read, M.E. (Diffusion in Metals Data Center, Metallurgy Division, Institute for Materials Research, National Bureau of Standards, Washington, D.C. 20234). J. Phys. Chem. Ref. Data 4: No. 1, 177-250 (Mar 1975).

A survey, comparison, and critical analysis is presented of data compiled from the scientific literature concerning diffusion in copper alloy systems involving elements in Groups IA, IIA, IIIB, IVB, VB, VIB, and VIIB. Here the term "copper alloy system" is interpreted in the broadest sense. For example, the review of diffusion in the Cu-M system reports all diffusion situations which involve both copper and element M, including diffusion of Cu in M or in any binary, ternary or multicomponent alloy containing M; diffusion of M in Cu or in any alloy containing Cu; and diffusion of any element in any alloy containing both Cu and M. Topics include volume diffusion, surface diffusion, grain boundary diffusion, tracer diffusion, alloy interdiffusion, electromigration, thermomigration, dislocation-pipe diffusion, and diffusion in molten metals. An extensive bibliography is presented along with figures, tabular presentation of data and discussion of results. (auth)

1484 CRYSTAL FIELDS OF DILUTE Tb, Dy, Ho, OR Er IN Lu OBTAINED BY MAGNETIZATION MEASUREMENTS. Touborg, P.; Høg, J. (Department of Electrophysics, Technical University, 2800 Lyngby, Denmark). Phys. Rev. B 11: No. 7, 2660-2667 (1 Apr 1975).

Magnetization measurements are reported on single crystals of dilute Tb, Dy, Ho, or Er in Lu. These measurements were performed in the temperature range 1.5–100 K and field range 0–6 T and include measurements of initial susceptibility, isothermal and isofield

magnetization, and basal-plane anisotropy. The results show features similar to the corresponding Y-*R* alloys, where *R* is a rare earth. Crystal-field and molecular-field parameters could be unambiguously deduced from the experimental data. The effects of crystal-field level broadening were investigated and demonstrated for Ho. Comparison of the Y-*R* and Lu-*R* results makes possible an estimate of the crystal-field parameters in the pure-rare-earth metals. (auth)

1485 ANOMALOUS T_c-BEHAVIOUR OF $LaSn_3$ UNDER PRESSURE. Huang, S.; Chu, C. W.; Fradin, F. Y.; Welsh, L. B. (Cleveland State Univ., OH). Solid State Commun.; 16: No. 4, 409-412(15 Feb 1975).

The superconducting transition temperature T_C of $LaSn_3$ was measured up to ~22 kbar and was observed to increase through a maximum under hydrostatic compression. The anomalous T_C-behavior is attributed to a pressure induced Fermi surface topology change. (auth)

1486 JOSEPHSON EFFECT IN A PLANAR Pb-Sn-Pb PROXIMITY STRUCTURE. Romagnan, J. P.; Gilabert, A.; Laheurte, J. P.; Noiray, J. C. (Univ., Nice). Solid State Commun.; 16: No. 4, 359-361(15 Feb 1975).

Reliable S(lead)-N(tin)-S(lead) junctions using an original planar geometry have been studied. Above the critical temperature of tin, dc and ac Josephson behavior was observed for a tin film thin enough. Measurements are also reported of the supercurrent temperature dependence in agreement with a simplified proximity effect description. (auth)

1487 LANTHANUM OUGHT TO BE 4f-BAND METAL. Wittig, J. (Kernforschungsanlage Juelich GmbH, Ger.). Comments Solid State Phys.; 6: No. 1, 13-16(1974).

A discussion is presented as to whether or not La, in the strict sense, is a rare earth metal. At a recent conference it was thought that it is not, and relying on band structure calculations a theorist categorically declared that La had no 4f electrons. The present author argues that La is a real rare earth metal, and that an occupied 4f band should be postulated to account for the unusual physical properties of the metal, which include superconductivity considerations, the double hcp lattice structure, negative thermal expansion at low temperatures, and the low melting point. Comparisons are made with Ce. A fact arising is that 4f states, like 5f states, do not have to be magnetic. (UK)

1488 INTERACTION BETWEEN INTERSTITIAL HYDROGEN AND SUBSTITUTIONAL SOLUTE ATOMS IN SOLID SOLUTIONS OF NIOBIUM-BASE TERNARY ALLOYS. Matsumoto, T.; Sasaki, Y.; Hihara, M. (National Research Inst. for Metals, Tokyo). J. Phys. Chem. Solids; 36: No. 4, 215-220(Apr 1975).

The interaction was investigated by measurements of the hydrogen solubility and the influence of hydrogen charging on the half-width of the x-ray reflection lines in pure Nb, Nb-5% V, Nb-5% Mo, and Nb-5% Ta alloys. In Nb-5% V and Nb-5% Mo alloys, the solubility considerably increases with respect to pure Nb. On the other hand, the solubility hardly changes in Nb-5% Ta alloy. With addition of hydrogen, the half-widths in pure Nb and Nb-5% Ta alloy show a monotonic increase, but in Nb-5% V and Nb-5% Mo alloys they show a minimum. The results are explained by the interaction of hydrogen with substitutional solute atoms. The interaction is considered to be caused by the internal strain induced by the difference in atomic radii between substitutional and solvent (Nb) atoms. (auth)

1489 SPECIFIC HEATS OF NEPTUNIUM AND PLUTONIUM. Gordon, J. E. (Amherst Coll., MA); Hall, R. O. A.; Lee, J. A.; Mortimer, M. J. Cryogenics; 15: No. 3, 155(Mar 1975).

Results are reported extending previous measurements of the specific heats of neptunium and of plutonium (^{239}Pu), using a transient method for the lowest temperatures and also including the isotope ^{242}Pu which has a much lower α-activity. The temperature range has been extended down to 2.5°K for neptunium, 7.2°K for ^{239}Pu and to 4.1°K for ^{242}Pu. The γ values of the specific heats are tabulated. (UK)

1490 $N_{4,5}$ AUGER SPECTRA OF GADOLINIUM. Dufour, G.; Bonnelle, C. (Paris-6 Univ., 75 (France). Lab. de Chimie Physique). J. Phys. (Paris), Lett.; 35: No. 12, L-255-L-256(Dec 1974). (In French).

The $N_{4,5}$ Auger electrons emitted by a gadolinium target were analyzed. An autoionizing state is invoked to explain the spectrum. (FR)

1491 SPIN FLUCTUATIONS IN UAl_2 AND $PuAl_2$. Jullien, R.; Coqblin, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides). J. Phys. (Paris), Lett.; 35: No. 10, L.197-L.201(Oct 1974).

The NMR relaxation rate $1/T_1$ of the Al nucleus in both UAl_2 and $PuAl_2$ is computed within a theoretical model which considers the spin fluctuations due to the 5f electrons and which takes into account the temperature dependence of the Stoner susceptibility. Good agreement is obtained for both the decrease of $1/T_1T$ with temperature and the resistivity of UAl_2: finally the case of $PuAl_2$ is discussed. (FR)

Radiation Effects

Refer also to abstracts 952, 2368, 2475, and 2476.

1492 (AERE-TP-578) EFFECTS OF TEMPERATURE CHANGES ON VOID SWELLING. Bullough, R.; Hayns, M. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). [1974]. 26p. Dep. NTIS (US Sales Only) $4.00.

The established rate theory of Brailsford and Bullough for the swelling in irradiated materials is extended to allow the temperature to change during irradiation. When the temperature first falls, a secondary population of voids is nucleated and the theory presented determines both the incubation dose required to nucleate such voids and the kinetics of overall swelling resulting from the growth of the voids in such a bimodal distribution. Several illustrative examples are presented which demonstrate the versatility of the theory and the various possible physical consequences of such temperature changes. (6 fig) (auth)

1493 (COO-3158-35) AN IN-SITU FIELD ION MICROSCOPE STUDY OF IRRADIATED TUNGSTEN AND TUNGSTEN ALLOYS, II. The Recovery Behavior in Stages I and II: Experimental Results. Report No. 2347. Wilson, K. L.; Seidman, D. N. (Cornell Univ., Ithaca, N.Y. (USA). Materials Science Center). Dec 1974. Contract AT(11-1)-3158. 30p. Dep. NTIS $4.50.

The low temperature FIM isochronal annealing spectrum of four different purity levels of tungsten (resistivity ratios R of $5 \cdot 10^4$, $1.5 \cdot 10^4$, 50 and 15), irradiated in-situ with 30 keV W^+ ions to a dose of $5 \cdot 10^{12}$ ion cm^{-2} at 18 K, consisted of distinct recovery peaks at approximately 38, 50, 65 and 80 K with a small amount of recovery observed up to 120 K. The spectra were essentially identical between 18 and 120 K, but a fifth group of W specimens with approximately equal to 5 began to exhibit some deviations from the standard spectrum. This result indicates that the distribution of self-interstitial atoms (SIAs) produced by the ion irradiations in the W FIM tips was such that the SIA-SIA reaction dominated the recovery behavior. The isochronal peak width at half-maximum for the 38 K long-range SIA migration peak and the Stage II peaks in pure W were shown to be approximately equal to the value predicted by a diffusion model. The isochronal recovery spectra for W-0.5 at. per cent and 3 at. per cent Re alloys were radically different from the isochronal recovery spectra of pure W. For both W-Re alloys, the amount of recovery for the long-range migration peak was suppressed, and, for the 3 at. per cent Re alloy, it was almost eliminated. High-purity W (R equals $5 \cdot 10^4$), doped with 50-100 appm carbon, showed a 20 per cent reduction in the amount of recovery observed for the long-range migration peak at 38 K. (auth)

1494 (HEDL-TME-74-56) SIMULATED ANNEALING OF DISPLACEMENT CASCADES IN FCC METALS. 1. Beeler Cascades. Doran, D. G.; Burnett, R. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-2170. 22p. Dep. NTIS $4.00.

An important source of damage to structural materials in fast reactors is the displacement of atoms from normal lattice sites. A high energy neutron may impart sufficient energy to an atom to initiate a displacement cascade consisting of a localized high density of hundreds of interstitials and vacancies. These defects subsequently interact to form clusters and to reduce their density by mutual annihilation. This short term annealing of an isolated cascade has been simulated at high and low temperatures using a correlated random walk model. The cascade representations used were developed by Beeler and the point defect properties were based on the model of gamma-iron by Johnson. Low temperature anneals, characterized by no vacancy migration and a 104 site annihilation region (AR), resulted in 49 defect pairs at 20 keV and 11 pairs at 5 keV. High temperature anneals, characterized by both interstitial and vacancy migration and a 32 site AR, resulted in 68 pairs at 20 keV and 18 pairs at 5 keV when no cluster dissociation was permitted; most of the vacancies were in immobile clusters. These high temperature values dropped to 40 and 14 upon dissolution of the vacancy clusters. Parameter studies showed that, at a given temperature, the large AR resulted in about one-half as many defects as the small AR. Clusters size

distributions and examples of spatial configurations are included. (auth)

1495 (LYCEN-74-31) OXYGEN DIFFUSION IN METALLIC SAMPLES AFTER NEUTRON IRRADIATION IN WATER. Boissier-Chermette, M. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 (France)). 1974. 53p. (In French). INIS.

Strong diffusion of oxygen was observed in iron and niobium samples, after neutron irradiation in water. Such diffusion does not occur in nickel, molybdenum and platinum samples. Oxygen concentration profiles were obtained by a direct observation of nuclear reactions, together with ionic sputtering. The main parameters (heat treatment, surface state, crystal structure, oxygen initial concentration, sample immersion in water, nature of ionizing radiation) were investigated in the case of iron samples. The role of hydrogen in the phenomenon and the effect of radiations on superficial oxides were emphasized through a low energy nuclear analysis. The results obtained show that the creation of defects by irradiation is a negligible factor and that aqueous corrosion, increased by irradiation and water radiolysis, is the most important factor. The role played by hydrogen in the oxygen penetration is discussed. (FR)

1496 (UCLA-34P172-13) HIGH VOLTAGE ELECTRON IRRADIATION STUDIES OF SEVERAL OVERAGED GAMMA/GAMMA' ALLOYS. Ardell, A. J.; Mastel, B.; Laidler, J. J. (California Univ., Los Angeles (USA). Dept. of Materials). Aug 1974. Contract AT(04-3)-34 23p. Dep. NTIS $4.25.

The formation of irradiation-induced dislocation loops was studied in four Ni-base gamma/gamma' alloys, severely overaged so that the influence of individual gamma/gamma' interfaces could be investigated. The alloys, Ni–14.07 percent Al, Ni–12.68 percent Si, Ni–14.1 percent Cr–10.1 percent Al, and Nimonic PE-16 were irradiated, using 1-MeV electrons, for various times at an irradiation temperature of 425°C to produce dislocation loops. Void formation was also induced in overaged PE-16 at an irradiation temperature of 490°C. In the binary alloys the distribution of dislocation loops was fairly uniform throughout the gamma and gamma' phases, the semicoherent interfaces having no apparent influence on loop formation. The Ni–Si alloy was more radiation damage resistant than the Ni–Al alloy. In the ternary alloy the nucleation and growth of dislocation loops was evidently somewhat easier in the matrix than in the gamma' phase, but the coherent gamma/gamma' interfaces did not influence the spatial distribution of loops. The situation in PE-16 was vastly different; both dislocation loops and voids nucleated and grew preferentially in or near the coherent gamma/gamma' interfaces. A model is proposed which qualitatively accounts for these observations by invoking the large difference in the chemical constituents of the gamma and gamma' phases in PE-16 and the manner in which this factor affects the production of Frenkel pairs and the nucleation of dislocation loops and voids. Some consequences of this model are briefly discussed. (auth)

1497 FERRITE FORMATION IN NEUTRON IRRADIATED TYPE 316 STAINLESS STEEL. Stanley, J. T. (Arizona State Univ., Tempe); Garr, K. R. Met. Trans.; 6A: No. 3, 531-535 (Mar 1975).

Magnetic measurements were made on Type 316 stainless steel specimens that were neutron irradiated to fluences of 1.8×10^{22} neutrons/cm^2 at 425°C and 3.5×10^{22} neutrons/cm^2 (E greater than 0.1 MeV) at 500 and 600°C. A significant increase of magnetization was observed for the irradiated specimens compared to the unirradiated specimens. The shape of the magnetization vs field curves showed that the irradiated specimens contained many small superparamagnetic particles. The magnetic particles are assumed to be the ferrite phase although other possibilities cannot be excluded. The amount and distribution of the magnetic phase varied with pre-irradiation and post-irradiation heat treatment. The maximum value of magnetization was equivalent to 3.6 percent ferrite in a specimen annealed 100 h at 760°C before irradiation and 1 h at 500°C after irradiation at 425°C. (auth)

1498 NEUTRON EMBRITTLEMENT OF WELDABLE QUENCHED AND TEMPERED REACTOR PRESSURE VESSEL STEELS. Pachur, D.; Sievers, G. Stahl Eisen; 95: No. 2, 45-50(Jan 1975). (In German).

Irradiation tests were conducted at 300 and 400°C with neutron fluences of 10^{19}, 5×10^{19} and 10^{20} n/cm^2 on base material, weld metal, and heat-affected zones of submerged-arc welded joints of four weldable quenched and tempered steels containing 0.11 to 0.22% C, 22 to 1.44% Mn, 0.010 to 0.012% P, 0.11 to 1.57% Co, 0.11 to 0.15% Cu, about 0.5% Mo, 0.63 to 3.88% Ni, and 0.01 to 0.2% V. The effects of irradiation on 0.2% yield strength, ultimate tensile strength, elongation and reduction of area and also on the notch toughness transition temperature were determined. Temperature dependence of the irradiation influence and superposition of aging phenomena were also studied. (GE)

1499 FORMATION AND ANNIHILATION OF POINT DEFECT CLUSTERS IN METALS IRRADIATED BY 3 MV ELECTRON MICROSCOPE. Kiritani, M.; Yoshida, N. (Osaka Univ.). Cryst. Lattice Defects; 4: No. 2, 83-94(1973).

Defects produced in gold, iron, aluminum, and an aluminum alloy by the irradiation of electrons up to 3 MeV in an electron microscope have been studied. In gold, interstitial type dislocation loops and small vacancy type defects are generally formed successively. Cessation of the nucleation of interstitial clusters is caused by the decrease of interstitial concentration by the accumulation of vacancies. Preexisting defects such as surfaces, grain boundaries, and dislocations absorb interstitial clusters. Vacancies of the same amount as that of interstitials escaped to these sinks accumulate in the crystal and result in the formation of vacancy clusters. Stacking fault tetrahedra in gold convert into dislocation loops and shrink by irradiation. There is preferential nucleation of loops in aluminum on faulted dislocation loops. The irradiation produced defects in Al–Zn alloy are much less compared with those in pure aluminum. The growth and shrinkage behavior of the vacancy type dislocation loops and helical dislocations in aluminum and its alloy suggests the existence of a long range attractive interaction between a dislocation and interstitials and also the existence of the trapping of interstitials by solute atoms. (auth)

1500 PLASTIC DEFORMATION OF METAL INDUCED BY AN INTENSE ELECTRON BEAM WITH A DURATION OF 10^{-6} TO 10^{-7} SEC. Shubin, A. F.; Rotshtein, V. P.; Proskurovskii, D. I. (Inst. of Atmospheric Optics, Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 50-53(1974). (In Russian).

The preliminary investigation of the dislocation structure of Cu samples irradiated at a density of 10^7 W/cm^2 showed that in the irradiated zone the dislocation density was substantially increased and deformation twins were formed. The presence of deformation twins indicates the propagation in the sample of waves of thermoelastic stresses caused by the superfast ($\sim 10^{10}$ °/s) heating of the metal surface. (JSR)

1501 RADIATION DAMAGE IN COPPER SINGLE CRYSTALS. Sood, D. K.; Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Vac. Sci. Technol.; 12: No. 1, 463-467 (1975).

Mo, Au, and Cu ions of 150–350-keV energy were implanted, off axis, in [110] Cu single crystals at a dose of 10^{16} ions/cm^2. The radiation damage and its annealing are studied by backscattering and channeling of a 3.5-MeV alpha-particle beam. There is no significant surface disorder. The radiation damage, however, was found to extend to rather large depths, up to 16 times the projected range of the implanted ions. Annealing of the disorder caused by 150-keV Mo ions was studied up to 900°C. The disorder anneals gradually at rather high temperatures accompanied by a marked decrease in the disorder depth. This suggests depletion of the disorder from within the crystal towards the surface. The disorder was also studied as a function of substrate temperature, during implantation, from –130 to 350°C. Results are interpreted in terms of the existing radiation damage theory and arguments based upon consideration of surface stress. (auth)

1502 SURFACE STRESSES IN ION-IMPLANTED STEEL. Hartley, N. E. W. (Atomic Energy Research Establishment, Harwell, Eng.). J. Vac. Sci. Technol.; 12: No. 1, 485-489(1975).

A capacitance probe apparatus is described which was used to detect the deflection occurring during ion implantation of thin specimens of annealed steel. The deflection is related to the introduction of a surface compressive stress. 100-keV argon ion implantation is found to produce surface stresses of several thousand lbs/in.^{2} which reach a maximum at a dose approximately 5.0×10^{16} ions-cm^{-2}. Light ions, such as nitrogen, which form chemically stable compounds within the steel, generate similar stresses within the surface such that a macroscopic deflection of the specimen can be observed. In this case very high doses are required to maximize the stress (approximately 10^{17} ions-cm^{-2}). Results are interpreted with reference to damage mechanisms and nitride formation and are discussed in relation to the mechanical property changes previously reported. (auth)

1503 FLUX DEPENDENCE OF VOID NUCLEATION AND VOID GROWTH IN 2.8-MeV NICKEL-ION-IRRADIATED NICKEL. Westmoreland, J. E. (Naval Research Lab., Washington, DC); Malmberg, P. R.; Sprague, J. A.; Smidt, F. A. Jr. J. Vac. Sci. Technol.; 12: No. 1, 511-515(1975).

Swelling in reactor materials can be simulated, at least qualitatively, by irradiation with heavy ions in a small fraction of the time required with neutron irradiation. However, the 10^3–10^5 higher production rate of initial damage which makes simulation

feasible may also obscure subtle microstructural changes. Thus, the dose rate effects need to be understood. The present investigation obtained a quantitative comparison between the damage parameters in 2.8-MeV nickel-ion-irradiated nickel, where the nickel ion flux was the only variable, being changed by a factor of 100. Preliminary results of studies of some of the samples of this investigation were described at a recent conference. The paper presents further analyses of these and other samples and comparison with theories of void nucleation and void growth. (auth)

1504 SWELLING STUDIES OF VANADIUM AND A VANADIUM-1 WT PERCENT TITANIUM ALLOY USING ION SIMULATION TECHNIQUES. Santhanam, A. T.; Taylor, A.; Kestel, B. J.; Steves, C. (Argonne National Lab., IL). J. Vac. Sci. Technol.; 12: No. 1, 528-531(1975).

The void swelling of high-purity vanadium (HPV) and V-1 Ti was investigated by irradiating the samples side by side with 3-MeV $^{51}V^{+}$ ions to damage doses between 2.4 and 54 dpa at 700°C. Examination of the irradiated samples by transmission electron microscopy revealed that voids and dislocation networks had formed at 2.4 dpa in HPV and the swelling increased less than linearly with dose. In contrast, V-1 Ti showed negligible swelling even at 54 dpa. The swelling resistance of V-1 Ti to large doses is believed to be, at least in part, due to irradiation-induced precipitation. (auth)

1505 SIMULATION OF FIRST-WALL RADIATION EFFECTS. Logan, C. M.; Anderson, J. D.; Hansen, L. F. (Univ. of California, Livermore). J. Vac. Sci. Technol.; 12: No. 1, 536-538(1975).

Many of the effects induced in metals as a result of exposure to a radiation environment are intimately associated with the energy of primary recoil atoms (PKAs). Protons with an energy of 16 MeV closely reproduce the PKA energy spectrum which will be present at the first wall in a D-T fusion reactor and should therefore closely reproduce the radiation effects induced by PKAs in the first wall. A preliminary experiment with protons was conducted to measure the sputtering rate and to look for the phenomenon of chunk emission recently observed by Kaminsky and co-workers in samples exposed to 14-MeV neutrons. We are also able to observe the average projected transport range of activated PKAs. (auth)

1506 HIGH-TEMPERATURE STAGES IN THE ANNEALING OF IRRADIATION DEFECTS IN REFRACTORY BCC-METALS. Zakharova, M. I.; Solov'ev, V. A.; Bykov, V. N. At. Energ. (USSR); 38: No. 2, 78-81(Feb 1975). (In Russian).

A study of defects in single crystals of molybdenum and tungsten after irradiation in the BR-5 reactor at 470 ± 30°C by an integrated neutron flux of $1.4 \cdot 10^{22}$ n/cm^2 has been conducted by measuring specific electric resistance. The experimental data were processed by means of a computer. There have been found three stages in the annealing of irradiation defects; stages V and VI break down into sub-stages. Maximum rates of annealing, the activation energy of irradiation defects and temperature intervals of stability of the stages have been determined. An interpretation of the stages of annealing is given and types of irradiation defects are defined. (auth)

1507 SCATTERING OF IONS BY THE REAL SINGLE CRYSTAL SURFACE DAMAGED UNDER ION BOMBARDMENT. Parilis, E. S.; Turaev, N. Y.; Umarov, F. F. (Inst. of Electronics, Tashkent). Radiat. Eff.; 24: No. 3, 207-213(1975).

The experimentally observed ion scattering within the shade zone, and the existence of a discrete structure of the scattered ion spectrum in a wide range of glancing angles, cannot be explained within the framework of the concept of an ideal surface. The scattering of ions on such defects of the structure as individually protruding atom steps, pairs of atoms, and atomic vacancies in surface chains can be represented in a model as successive collisions, within two atoms located one from the other at distances D divisible by the interatomic distance in an ideal crystal. The results of electronic computer calculations for a two-atom model have been compared with analytical evaluations, and the sphere of application of the latter has been estimated. Calculations based on the real single crystal surface damaged under ion bombardment make it possible to explain the experimental data. Consideration for the real surface and the predominant ionization of the particles which had been subjected to a lesser number of collisions calls for serious attention to the two-atom model. (auth)

1508 STUDY OF A MODEL OF HOMOGENEOUS VOID NUCLEATION IN AN IRRADIATED METAL. Lott, M.; Fiche, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section de Physique Experimentale). pp 25-64 of Les Phenomenes de Precipitation et Leurs Consequences sur les Proprietes de Quelques Familles d'Alliages Industriels. Saclay, France; Institut National des Sciences et Techniques Nucleaires ([nd]). (In French).

From 16th colloquium on metallurgy; Saclay, France (25 Jun 1973).

A quasi-chemical model of homogeneous void nucleation was studied, assuming that the only mobile species are vacancies and interstitials. In this model the nucleation and growth phases are not distinct. It is found that the equation governing the void size change with time resembles the diffusion equation in a force field. This tends always to remove voids of a particular size, known as the critical size, below which the voids have a natural tendency to disappear and above which they become enlarged. It is by diffusion that voids can pass through the critical size and thus set up a nucleation current. The article discusses the hypotheses normally taken to calculate the amount of vacancy and interstitial capture by the voids, quantities essential for a nucleation and growth model. The effect of vacancy-interstitial recombinations is taken into account and it is shown that the capture coefficients to be used can be substantially increased as a result. The complete numerical resolution of the equations was accomplished and used for comparison with results published earlier. It was found especially that the time constants for the establishment of equilibrium at the critical size were generally over-estimated. It was also shown that beyond the critical size it was unnecessary to treat the whole equation, the force field alone accounting well enough for the void development which can then be likened to a simple growth. In view of these observations the nucleation model should be suitable for the study of nucleation and growth in the presence of mobile gas atoms in the matrix; these can be trapped by voids which they would then stabilize, increasing their probability of growth. (FR)

1509 IRRADIATION RESULTS ON NATURAL URANIUM-GRAPHITE-GAS REACTOR FUEL ELEMENTS. Arnaud, G.; Blanchard, P.; Millet, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles); Berry, J. L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Chimie). Bull. Inform. Sci. Tech. (Paris); No. 196, 5-26(Oct 1974). (In French).

The characteristics of the three types of fuel elements in service and their working conditions are outlined briefly, after which the main irradiation results are reviewed. The fuel swelling is examined, together with its repercussions on other potentially troublesome phenomena (porous zones, release of a fission gas fraction, increase in oxidation rate). The cladding behaves satisfactorily; the main problems of its resistance are discussed. The behavior of the ring-shaped graphite-core elements BUGEY 1 is good and the failure frequency low, which means that the performance of these elements can be improved (research in progress). (FR)

1510 CARBIDE FORMATION ON Nb SURFACES DURING HIGH-TEMPERATURE H IRRADIATION. Thomas, G. J.; Bauer, W. (Sandia Labs., Livermore, CA). J. Vac. Sci. Technol.; 12: No. 1, 490-495(1975).

The formation of "star-shaped" features approximately 1–10 mu in size were observed on the surfaces of Nb samples after implantation with 150-keV H^{+} at 975–1275°K. Depending on specific conditions of temperature, vacuum, and surface preparation, they are sometimes found only within the implanted region, and sometimes over the entire sample surface. Scanning and transmission electron microscopy, and scanning Auger analysis, indicate that the features are due to the formation of Nb_2C precipitates. These results suggest that carbide growth can occur on Nb surfaces at high temperatures under CTR-like vacuum conditions, and that the formation of carbides can be enhanced in a radiation environment. This process can have important consequences on the use of Nb for CTR first wall applications. (auth)

Other Materials

Refer also to abstracts 91, 120, 145, 381, 423, 952, 1460, and 1471.

1511 (AD/A-003172) CELLULAR CONCRETE STUDIES. Report 2. Evaluation of Crushed Cellular Concrete. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)) Dec 1974. 61p. NTIS $4.25.

Drilled cores and excavated pieces of consolidated cellular concrete backpacking from around a test structure that had been subjected to shock loading were evaluated and compared with cellular concrete that had not been loaded. The consolidation of the cellular concrete from around the structure was quite substantial, with essentially all of the entrained air bubbles in the concrete being collapsed. However, densities obtained from the

cores indicated that the amount of consolidation experienced by the concrete around the structure was not uniform. The internal structure and composition of the hardened cement paste did not appear to have been altered appreciably. The compressional wave velocity of the consolidated backpacking was comparable with that of the same material before consolidation. The behavior of the cellular concrete appeared to follow suggested failure envelopes for that material. (auth)

1512 (AED-CONF-74-465-019) RESISTANCE OF DUROPLASTS AGAINST IONIZING BEAMS. Gilfrich, H. P.; Roesinger, S.; Wilski, H. (Farbwerke Hoechst A. G., Frankfurt am Main (F.R. Germany)). 1974. 5p. (In German). INIS.

From discussion meeting: Radiation chemistry of the polymers of the Gesellschaft Deutscher Chemiker; Garching/Muenchen, F.R. Germany (23 Oct 1974).

Polypropylene foil Hostalen PPN, wires, polystyrol plates Hostyren N7001, phenol formaldehyde resin, polyester resin, and melamine formaldehyde resin of various thicknesses were irradiated with electron beams or gamma rays and examined for their radiation resistance. (GE)

1513 (AERE-TP-581) INTERSTITIAL DEFECTS IN IRRADIATED ALKALI HALIDES. Catlow, C. R. A.; Diller, K. M.; Norgett, M. J. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Sep 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

Calculations are used to investigate the interaction of halogen atom interstitials defects in NaCl. It is concluded that H centres, present at low temperatures, will react on becoming mobile to give a defect comprising a molecule in a (100) vacancy pair, the formation of which was indicated in the recent electron microscopy studies of Hobbs, Hughes and Pooley (1973). (auth)

1514 (FZK-365) EVALUATION OF CRYOGENIC INSULATION MATERIALS AND COMPOSITES FOR USE IN NUCLEAR RADIATION ENVIRONMENTS. Materials Test and Propellant Heating Test. Quarterly Progress Report, 1 November–31 January. Kerlin, E. E.; Elliott, R. A.; Crabtree, R. D. (General Dynamics/Fort Worth, Tex. (USA)). Feb 1969. 59p. Dep. NTIS $6.00.

Results of research are presented on reactor materials evaluation and rocket propellant heating. Materials tested include thermal insulation and materials used in liquid level sensing, radiation measurement, and valve seals. Research on propellant heating was devoted to behavior of liquid hydrogen in tanks. (JRD)

1515 (GKSS-74/E/12) TRANSPORT OF FISSION PRODUCTS THROUGH MATRIX GRAPHITE. P. 1. Transport of Active and Inactive Strontium. Hattenbach, K.; Melkonian, G. A.; Ruckdeschel, A.; Williamowski, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany). Inst. fuer Werkstofftechnologie). 1973. 11p. (In German). INIS.

7 figs.; 9 refs. Published in Z. Phys. Chem. (Frankfurt), 87 (1973) p. 94-103.

Penetration of strontium out of a cylindrical source (diam. = 0.8 mm), located in the middle of a graphite cylinder (diam. = 5 mm) into the surrounding was investigated isothermally within a temperature range of $850 \leq T \leq 1{,}150°C$ and diffusion times being $0.16 \leq t \leq 90$ hr. To establish concentration profiles, the strontium contents in the turned-off graphite layers were determined at high Sr-concentration of the source by means of atomic absorption, at low concentrations when operating with Sr-85 as tracer by activity measurements. To evaluate experimental data, the connection between Einstein's displacement square with the diffusion coefficient was applied. From the temperature dependence of the coefficient an activation energy of 59 ± 3 kcal for the transport phenomenon—according to the Arrhenius equation—could be calculated. (GE)

1516 (N-74-12283) PROPERTIES OF VACUUM-EVAPORATED BORON FILMS. Feakes, F. (National Research Corp., Billerica, Mass. (USA)). Aug 1973. 82p. (NASA-CR-136124). NTIS $6.25.

Work on the properties of thin boron films made by vacuum evaporation of elemental boron using an electron beam as the energy source is reported. The program is aimed at characterizing the properties of vacuum evaporated films. The work was directed toward those variables considered to be important in affecting the tensile strength of the boron films. In general, the thickness of the films was less than 0.002 in. The temperature of the substrate on which the boron was condensed was found to be most important. Three distinctly different forms of boron deposit were produced. Although the transition temperature was not sharply defined at substrate temperatures of less than approximately 600°C, the boron deposits were amorphous to x-ray. If the substrate were highly polished, the deposits were black and mirror-like. For substrates with coefficients of thermal expansion close to that of boron, the deposits were then continuous and uncracked. Results of the studies suggest that the potential continues to exist for film-type composites to have both high strength and high modulus. (STAR)

1517 (TID/SNA-1513) IMPROVED GRAPHITE SYSTEMS FOR ADVANCED FUEL ELEMENT FABRICATION. Whittaker, M. P. (Great Lakes Research Corp., Elizabethton, Tenn. (USA)). 19 Aug 1971. 73p. Dep. NTIS $6.75.

For Westinghouse Electric Corp., Pittsburgh.

Objectives were to prepare experimental flour samples, to investigate possible replacements for Thermax filler in the fuel element fabrication, and to characterize and evaluate pitch/furan binders. (DLC)

1518 (TID/SNA-1654) IRRADIATION TEST REPORT ER-7852: MATERIALS AND COATINGS, PROJECT NERVA. (AMF Atomics, Greenwich, Conn. (USA)). 12 Aug 1963. 34p. Dep. NTIS $4.75.

All specimens of protective coatings subjected to neutron and gamma radiation only were judged to have suffered no objectionable damage under the conditions of the test. The mixed radiation field exposures were 64 megarads due to gammas and 2.5×10^{16} nvt of thermal neutrons delivered in 40 continuous hours of exposure. The temperature recorded during the mixed exposure was 166°F. The gamma only exposure was 13 megarads delivered in three weeks of almost continuous exposure at varying intensities. (26 figs.) (auth)

1519 (WANL-TMI-397) EXPERIMENTAL DETERMINATION OF THERMAL CONDUCTIVITY OF GRAPHITE FELT AT ELEVATED TEMPERATURES, IN HYDROGEN AND NITROGEN ATMOSPHERES. Makiel, J. M. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Nov 1962. 14p. Dep. NTIS $4.00.

The measurements were made up to 3,600°F using an electric resistance furnace and enclosing the felt in a steel tube of known conductivity. The short comings of the experiments are discussed. (DLC)

1520 (WANL-TMI-1433) GRAPHITE SUBLIMATION: A LITERATURE REVIEW. Pinchok, R. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Apr 1965. 19p. Dep. NTIS $4.00.

The most favored value of heat of vaporization, starting with 124 kcal in the thirties, was gradually shifting to 170 kcal by the late forties; there was then an interlude during which an intermediate value gained a brief ascendancy, followed by a vigorous come-back of the highest value. The swing to 170 kcal, sparked by the mass spectroscopic results, has gained momentum on all sides. The empirical predictions of Vidale using the best experimental values obtained must be considered as the best source for initial input data for vapor pressures, sublimation rates, and heats of vaporization of graphite at this writing. The lack of correspondence between the data obtained by various investigators for the heat of sublimation and the vapor pressure of carbon prevents giving any single figure for evaporation coefficients. A table summarizes the best values from the literature for evaporation coefficients. The values of Burns, et al., will be used as input data for evaporation coefficients of C_1, C_2, and C_3 in the initial studies. C_1, C_2, and C_3 are the three important species which will be considered. C_4 and C_5 will be considered and will have evaporation coefficient values of unity. (auth)

1521 (WANL-TMI-1492) TENSION TEST ON FIBER–GRAPHITE PROTOTYPE TIE ROD. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Jun 1965. 6p. Dep. NTIS $4.00.

Results of tests on fiber–graphite tie rods are presented. Failure was indicated by a sudden release of load to less than one-half the maximum value but with no evidence of surface cracking. Upon further movement of machine crosshead, the graphite cloth weave showed separation and eventually broke. Thus, failure was initiated in the brittle core. After slicing the tapered end of a specimen, it was found that the initial failure was in a cement joint at the end of the solid core. Results show that the fabrication technique used in this tie rod prototype will not produce the desired strength capabilities of the graphite fibers. The following improvements are recommended to overcome apparent deficiencies in the present designs: (1) If the solid core is used, the tapered and plugs should be made as an integral part of the rod or a shear cement joint could be employed. (2) A bundle of axial graphite fibers should be substituted in place of solid graphite core. (3) The outer covering should be wound with graphite fibers in the axial direction in place of the present 45° angle. (auth)

1522 (WANL-TMI-1657) METHOD FOR APPROXIMATING EQUIVALENT CORROSION TIME FROM EXPERIMENTAL DATA. Wagner, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA) Astronuclear Lab.). Mar 1966. 8p. Dep. NTIS $4.00.

A FORTRAN program was written for a method of comparing equivalent corrosion time at a particular temperature level based on transient experimental temperature vs time data. Equations are derived for graphite removal. (DLC)

1523 (WANL-TMI-1863) METHOD FOR APPROXIMATING EQUIVALENT CORROSION TIME FROM EXPERIMENTAL DATA. Kolberg, K. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Dec 1967. 14p. Dep. NTIS $4.00.

A Fortran program for the CDC 6600 computer was written to determine the equivalent corrosion time at a particular temperature based on the experimental temperature–time curve. Equations are derived for the rate of carbon removal from a graphite surface. (DLC)

1524 (WANL-TMI-1963) THERMAL SHOCK OF GRAFOIL. RD:TS:143: Preliminary Report. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Feb 1969. 8p. Dep. NTIS $4.00.

Results of tests to determine the effects of vaporization and outgassing of petrolatum between pyrofoil layers are discussed. It appears that the gaseous petrolatum finds escape paths that do not damage the pyrofoil. Favorable test results are noted but they are not conclusive. Further testing is proposed. (JRD)

1525 (WANL-TNR-011(Rev.)) PROPERTIES OF GRAPHITE CLOTH. Manjoine, M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Jan 1962. 12p. Dep. NTIS $4.00.

Graphite cloth can be precompressed to form a resilient graphite spring. The room temperature resilience is maintained at −320°F. High damping can be expected under vibratory loading because of the large hysteresis loop. Creep occurs in a pack of layered cloth resulting in additional compressibility with time under constant loading pressure or relaxation of the pressure under constant deflection. The static coefficient of friction in air of graphite cloth on graphite cloth is 0.3 and that for cloth on steel is about 0.2. (auth)

1526 (WANL-TR-6624) TRIP REPORT TO GENERAL DYNAMICS, FORT WORTH, TEXAS. Albertin, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Apr 1971. 3p. Dep. NTIS $4.00.

Eighteen ZTA graphite WOL-1 X-type fracture toughness specimens were scheduled for testing at the Nuclear Aerospace Research Facility of the Fort Worth Division of General Dynamics to determine the effects of nuclear radiation on the fracture toughness properties. Twelve of the specimens received a radiation dose of approximately 10^{19} nvt at liquid nitrogen temperature and were to be tested at liquid nitrogen and room temperature. However, experimental difficulties were encountered at the beginning of the testing program and were the result of an unexpectedly high potential energy stored in the specimens due to radiation damage which caused many specimens to fracture violently prior to tensile testing. The stored energy problem is described in a chronological manner by discussing the actual events which were observed on individual specimens during testing. A description of these events is given. Six 0.5 inch thick X-type WOL fracture toughness specimens were provided in a test program to study the effect of radiation damage on the fracture toughness of tungsten–2% ThO_2. Two of the six specimens were reserved for annealing studies at elevated temperature. The irradiation fluence level was 8×10^{18} nvt. One set of control and irradiated specimens was tested at LN_2 and room temperature. No significant differences in failure loads were observed indicating no effect of temperature or radiation damage on the fracture toughness parameter K_{Ic}. In all cases, the fracture toughness parameter was estimated to be in the 8 to 9 ksi $\sqrt{\text{in}}$ range. (auth)

1527 EFFECT OF CARRIER LIFETIME ON LASER-INDUCED DAMAGE IN SILICON. Matsuoka, Y.; Usami, A.; Shimazaki, K. (Meijo Univ., Nagoya, Japan). J. Phys., D (London); 8: No. 1, L1-L2(11 Jan 1975).

An experimental study was made of the damage to p-type Si crystals, whose carrier lifetime has been reduced by neutron and γ irradiation. No correlation between the carrier lifetime and the damage threshold was found in the experiment. (auth)

1528 INTERSTITIAL DEFECTS INVOLVING CARBON IN IRRADIATED SILICON. Brozel, M. R.; Newman, R. C.; Totterdell, D. H. J. (Univ. of Reading, Eng.). J. Phys., C (London); 8: No. 2, 243-248(21 Jan 1975).

Room temperature irradiation by either 2 MeV electrons or fast neutrons of silicon containing carbon and oxygen leads to the displacement of substitutional carbon into interstitial sites. These interstitials are mobile and some combine with oxygen impurities to form C(3) centers. The latter centers are themselves destroyed once the concentration of substitutional carbon becomes negligible. It is proposed that C(3) centers act as nucleation sites for the aggregation of intrinsic interstitials. (auth)

1529 INTERSTITIAL DEFECTS INVOLVING BORON IN IRRADIATED SILICON. Laithwaite, K.; Newman, R. C.; Totterdell, D. H. J. (Univ. of Reading, Eng.). J. Phys., C (London); 8: No. 2, 236-242(21 Jan 1975).

Silicon containing high concentrations of boron has been irradiated by 2 MeV electrons at room temperature. Initially, substitutional boron atoms are displaced into interstitial sites, but with prolonged irradiation there is a further interaction between B(i) and an intrinsic defect which is believed to be the Si(i). A similar effect is found in neutron-irradiated samples. A broad absorption band is observed in the latter samples which is not detected in electron-irradiated crystals. It is suggested that this band is associated with boron in highly disordered regions. The results are discussed in relation to atom location studies which utilize back-scattering techniques. (auth)

1530 X-RAY POWDER DIFFRACTION AND SOME THERMODYNAMIC DATA FOR $(NH_4)_4[UO_2(CO_3)_3]$. Bachmann, H. G. (Physikalisch-Chemische Forschung, Hanau, Ger.); Seibold, K.; Dokuzoguz, H. Z.; Muller, H. M. J. Inorg. Nucl. Chem.; 37: No. 3, 735-737(Mar 1975).

X-ray powder diffraction data for the title compound, tetraammonium tricarbonatouranate, are presented. DTA/TGA/DTG analyses confirmed earlier work and allowed the determination of the heat of thermal decomposition and the molecular heat capacity. The former amounts to 119 ± kcal $mole^{-1}$ at 459°K, and the latter is 115 ± 10 cal $mole^{-1}$ deg^{-1} in the temperature range between 330° and 390°K. (auth)

1531 IONIC THERMOCURRENT AND OPTICAL-ABSORPTION MEASUREMENTS IN KCl:Sr UNDER REACTOR IRRADIATION. Sordi, G. M. (Instituto de Energia Atomica, Sao Paulo, Brazil); Watanabe, S. Nuovo Cim., 25B: No. 1, 145-158(11 Jan 1975).

Radiation damage in KCl crystals doped with Sr^{++} was studied using thermoionic-current techniques (ITC) and optical absorption measurements. Results of analyzing the radiation damage due to three different gamma-ray exposures confirmed the results obtained by other authors, namely the gamma irradiation creates F-type or V-type color centers and destroys a fraction of impurity-vacancy dipoles. Fast-neutron irradiation added to the gamma irradiation increases the efficiency of destruction of dipoles. The fast neutrons also provoke the appearance of a second ITC peak at temperatures near 123°K, which is unstable and disappears in a few days. On the other hand thermal neutrons bombarding the samples together with fast neutrons and gamma-rays leave unchanged the impurity-vacancy dipole concentration obtained after the gamma plus fast neutron irradiation. With thermal neutrons there is a high background current, and the peak resolution is only possible when thermally and electrostatically polarizable electrical carriers have largely disappeared. For this reason it is impossible to compare the 123°K peak obtained with and without thermal neutrons. (auth)

1532 BEHAVIOR OF HIGH POLYMERS UNDER THE EFFECTS OF IONIZING RADIATIONS. Wilski, H. (Hoechst Aktiengesellschaft, Frankfurt am Main). pp 183-198 of Physik: grundlage der technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German).

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

The different processes occurring in high polymers under the effects of ionizing radiation are described. These include cross-linking and decomposition. Examples are given of each. (JSR)

1533 TEMPERATURE AND THERMAL CONDUCTIVITY OF LOW-DENSITY PYROLITIC GRAPHITE. Fridlender, B. A.; Neshpor, V. S.; Kapralov, V. K.; Miroshnichenko, A. G. (State Inst. of Applied Chemistry, Leningrad). High Temp. (USSR) (Engl. Transl.); 12: No. 3, 583-585(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 3, 671-673 (1974).

The thermal properties of precipitated graphite were measured as a function of temperature and sample density. The thermal and temperature conductivities increased with increasing temperature and with decreasing sample density over the temperature range 1500-2500 C. The latter effect is explained on the basis of an increased electron contribution resulting from a more disordered structure. (PMA)

1534 HELIUM SUPPLY AND UTILIZATION IN SCIENCE AND TECHNOLOGY. Schreckenberg, W. Gas Aktuell.; No. 3, 6-10(1972). (In German).

Gaseous and fixed helium have a series of physical and thermodynamic properties which make it irreplaceable in its many applications in science and technology. Many technologies have only become possible due to the unlimited availability of the gas. The properties of both isotopes differ considerably at low temperatures and exhibit physical anomalies which are of great theoretical interest. (GE)

1535 TOPOTACTIC DECOMPOSITION AND CRYSTAL STRUCTURE OF WHITE MOLYBDENUM TRIOXIDE–MONOHYDRATE: PREDICTION OF STRUCTURE BY TOPOTAXY. Oswald, H. R.; Guenter, J. R.; Dubler, E. (Univ., Zurich). J. Solid State Chem.; 13: No. 4, 330-338(Apr 1975).

Single crystals of the white $MoO_3 \cdot H_2O$ modification ("alpha-molybdic acid") were transformed by heating to 160°C into perfect pseudomorphs built up from oriented MoO_3 crystallites of known structure. From the mutual orientation relationship of the unit cells of both phases involved in this topotactic reaction, as determined by X-ray photographs, a model for the so far unknown crystal structure of white $MoO_3 \cdot H_2O$ could be deduced. Independently, this structure was determined by X-ray diffractometer data then: space group P $\bar{1}$, a equals 7.388, b equals 3.700, c equals 6.673 A, alpha equals 107.8, beta equals 113.6, gamma equals 91.2°, Z equals 2. The structure was solved from the Patterson function and refined until R equals 0.088. It is built up from isolated double chains of strongly distorted $[MoO_5(H_2O)]$-octahedra sharing two common edges with each other. This result agrees well with the model derived from topotaxy, and it becomes evident how the MoO_3 lattice is formed through corner linking of the isolated double chains after the water molecules are removed. The study of topotactic phenomena seems rather generally applicable to deduce the main features of structures involved and for better understanding of structural relationships. (auth)

1536 PRODUCTION METHOD FOR A MIXED POWDER SERVING AS A BASE MATERIAL FOR PRODUCTION OF ARTIFICIAL GRAPHITE OR GRAPHITE-LIKE MATERIALS. Luhleich, H.; Nickel, H.; Pflaum, P.; Dias, F. (to Kernforschungsanlage Juelich GmbH). German (FRG) Patent 2,132,492/B/. 7 Mar 1974. 4p. (In German).

A method for the production of starting material for artificial graphite from known raw materials is described. The method involves injecting a slurry into a mixing chamber by means of a mixing nozzle in the carrier liquid, so that the filler grains are evenly coated with the binder and so that the mixture formed in the mixing chamber of filler, binder, carrier liquid and solvent, is heated to such an extent that the binder-coated filler grains strongly expel the carrier liquid which considerably simplifies the separation of the slurry and carrier liquid. (GE)

1537 ELECTRON IRRADIATED BULK N-TYPE GaAs. Mattauch, R. J.; Healy, M. P. (Univ. of Virginia, Charlottesville). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 825-828(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Bulk boat grown gallium arsenide doped to 1.7×10^{16} cm^{-3} with silicon was irradiated with 7 MeV electrons until the sample resistivity rose to the range 10^6 to 10^8 ohm-cm. Both resistivity versus temperature and Hall-effect versus temperature data indicate the presence of an acceptor-like level at E/sub c/-0.31 eV. Carrier removal was found to be approximately 2.3×10^{-3} cm^{-1} and annealing was found to occur near 500 K. (auth)

1538 CRYSTALLOGRAPHIC STUDIES OF SOME TRANSURANIC TRIHALIDES: $^{239}PuCl_3$, $^{244}CmBr_3$, $^{249}BkBr_3$, AND $^{249}CfBr_3$. Burns, J. H. (Oak Ridge National Lab., TN); Stevenson, J. N.; Peterson, J. R. J. Inorg. Nucl. Chem.; 37: No. 3, 743-749(Mar 1975).

Single-crystal x-ray diffraction methods were used to refine the structures of $PuCl_3$, $CmBr_3$, and $CfBr_3$. In $PuCl_3$ (UCl_3-type) the Pu ion has nine Cl-ion neighbors, three at 2.919(1) Å and six at 2.886(1) Å. A radius of 0.995 Å was derived for the six-coordinated Pu^{3+} ion. In $CmBr_3$($PuBr_3$-type) the eight-coordinated Cm ion has two Br ions at 2.865(6) Å, four at 2.983(4) Å, and two at 3.137(4) Å. Californium tribromide was shown to crystallize in both the $AlCl_3$– and $FeCl_3$-type structures. In the former type, the Cf ion is six coordinated and the three independent Cf-Br bond lengths are 2.795(9) Å, 2.827(11) Å, and 2.828(8) Å. Berkelium tribromide was prepared and shown by powder x-ray diffraction to exhibit the $AlCl_3$-, $PuBr_3$- and possibly $FeCl_3$-type structures. The new findings on $CfBr_3$ and $BkBr_3$ were used to produce a more complete description of the structural relationships among the lanthanide and actinide tribromides. (auth)

1539 SPECTROSCOPIC AND MAGNETIC PROPERTIES OF $UCl_4 \cdot 1.5(C_6H_5)_2PCl$. Duczmal, M.; Jablonski, A. (Technical Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 23: No. 1, 1-7(Mar 1975).

A new compound $UCl_4 \cdot 1.5(C_6H_5)_2PCl$ was synthesized. Results of analyses of the vibrational spectra indicated that a direct U–P bond was very likely to appear in this compound, although a possibility for bonding through the chlorine atom could not be completely ruled out. The absorption spectra of the compound were measured in tetrahydrofuran solution over the visible and near IR region and the magnetic susceptibility was measured from 4.2°K to room temperature. From 60 to 300°K $UCl_4 \cdot 1.5$ Ph_2PCl obeys the Curie–Weiss law with the effective moment of 3.31 B. M. and Weiss constant of –113°K. At lower temperatures the reciprocal of magnetic susceptibility deviates from the rectilinear shape towards lower values of χ^{-1}. (auth)

1540 DAMAGE PROFILES IN HIGH ENERGY C^+ BOMBARDED SILICON. Brack, K.; Gorey, E.; Schwuttke, G. H. (IBM Components Div., Hopewell Junction, NY). Cryst. Lattice Defects; 4: No. 2, 109-121(1973).

Annealing properties of subsurface amorphous layers produced through high energy C^+ implantation in silicon are reported. Resistivity profiling, transmission electron microscopy, and x-ray interferometry are used to study post bombardment and post annealing properties of the ion damage. Two different annealing stages are characteristic for the subsurface damage zone: (a) crystallization of the amorphous layer between 500 and 700°C and (b) silicon-carbide precipitation between 900 and 1200°C. It is shown that the phase transformation amorphous silicon to single crystal Si is accompanied by a 2.2% volume reduction of the subsurface damage zone. Carrier compensation effects due to bombardment are shown to produce a high resistivity surface layer which is stable at temperatures up to 500°C. At higher annealing temperatures subsurface single or multiple unstable high resistivity layers are formed and annealed out. Detailed investigations of the damage profile before and after annealing are presented. It is shown that the peak of the carbon distribution profile is located approximately 0.7 μm deeper than the peak of the damage profile. (auth)

1541 ATOMIC-DISPLACEMENT MECHANISM IN ION-BOMBARDED SEMICONDUCTORS AND INSULATORS. Dearnaley, G. (AERE, Harwell, England). Appl. Phys. Lett. 26: No. 9, 499-501 (1 May 1975).

A two-stage process of atomic displacement involving both elastic and inelastic energy transfer is presented, in order to account for the number and distribution of primary defects in ion-bombarded semiconductors and insulators. Some experimental tests are proposed. (auth)

1542 PURIFICATION OF GRAPHITE. Rumbo, E. R.; McAllan, J. V. (National Measurement Lab., Sydney). Lab. Pract.; 24: No. 2, 73-74(Feb 1975).

A laboratory technique is described for removing impurities from small amounts of graphite. The method involves boiling in 50% HCl for about 100 hours, followed by boiling in several changes of distilled water for 100 hours. The graphite is then heated under vacuum and held at temperatures between 1,250 and 1,800°C until outgassing is reduced and the pressure falls below 0.005 torr. This normally takes about 2 hours, and the sample is held under these conditions for at least a further 30 min. The effectiveness of the treatment is illustrated by tabulation of the impurities present in components machined from ATJ grade graphite and subjected to different temperatures after HCL treatment. (UK)

1543 URANIUM-SELENIUM COMBINATIONS IN THE USe–MSe SYSTEMS (M = Mg, Ti, V, Cr, Mu, Fe, Co, Ni). Noel, H. (Rennes-1 Univ., 35 (France)). Compt. Rend., Ser. C; 279: No. 12, 513-515(16 Sep 1974). (In French).

Transition element selenides and magnesium selenide combine with uranium selenide to form the following compounds: $MUSe_3$ (M = V, Cr, Co, Ni); $M'USe_3$ (M' = Mn,Fe); FeU_2Se_5; MU_3Se_{17} (M = Mg, Ti to Ni). These selenides are of the same type as the corresponding sulfides. (FR)

1544 BORN–MAYER INTERACTION POTENTIAL AND PROPERTIES OF ISOTOPIC LITHIUM HYDRIDE. Srivastava, S. P.; Saraswat, R. S. (Indian Inst. of Tech., Kanpur). J. Phys. Chem. Solids; 36: No. 4, 351-354(Apr 1975).

Bowman (J. Phys. Chem. Solids; 34:1754(1973)) has calculated the thermal expansion coefficient α in case of lithium hydride using the Born–Mayer interaction potential in an attempt to study the isotopic effects on α. However, the calculated values of α for ^{6}LiH, ^{6}LiD, ^{7}LiH, and ^{7}LiD by Bowman are smaller than the corresponding experimental values in every case which he attributed to be due to the simplistic nature of the theory used.

In this investigation the Grueneisen parameter, γ, and the thermal expansion coefficient, α, were calculated using a more satisfactory anharmonic model than that used in Bowman's investigation. Using the same Born–Mayer interaction potential, other properties have been calculated such as the reststrahlen frequency, the anharmonicity, the mode Grueneisen parameters, and the Anderson-Grueneisen parameter in an attempt to demonstrate further the validity of this model as a satisfactory ionic potential in case of isotopic crystals as well. (auth)

1545 CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF THE THREE PEROVSKITE MIXED OXIDES $Ba_2(MeU)O_6$ (Me = Ni, Co, Mn). Padel, L.; Grenet, J. C.; Poix, P. (Paris-11 Univ., 91 - Orsay (France)). Compt. Rend., Ser. C; 279: No. 12, 505-507(16 Sep 1974). (In French).

The three mixed oxides with a formula $Ba_2(MeU)O_6$ (Me = Ni, Co, Mn) are ordered perovskites. They are ferromagnetic at low temperature. (FR)

1546 ESR STUDIES OF DEFECT CENTERS TRAPPED IN IRRADIATED CALCIUM CHLORATE SINGLE CRYSTALS. Suryanarayana, D.; Sobhanadri, J. (Indian Inst. of Tech., Madras). J. Magn. Resonance; 16: No. 2, 274-282(Nov 1974).

Paramagnetic centers trapped in x- or γ-irradiated calcium chlorate dihydrate, $Ca(ClO_3)_2 \cdot 2H_2O$, single crystals were studied using ESR methods. The paramagnetic defects produced in this crystal at room temperature are ClO_2 (I), ClO_2 (II), Cl_2^-, O_3^-, and O^-. The ClO_2 centers are trapped at four magnetically inequivalent sites forming two pairs, viz., ClO_2 (I) and ClO_2 (II). The hyperfine parameters for ClO_2 (I) are slightly different from those of ClO_2 (II). This difference is attributed to the possible chemical inequivalency of the parent chlorate groups in the lattice. Such chemical inequivalency in this system has been predicted from NQR studies. When the irradiated crystal is exposed to 366 nm light from a 100-W mercury discharge lamp, these ClO_2 centers are fully bleached out, giving rise to a Cl_2^- center. This Cl_2^- (ν_k) center is stable at room temperature and is located at two magnetically inequivalent sites. Both ClO_2 and Cl_2^- centers have revealed "superhyperfine interaction" with one of the protons of water of crystallization. O_3^- and O^- are two other species identified at room temperature. (auth)

1547 AMORPHIZATION DEPENDENCE ON THE THERMAL CONTACT BETWEEN A ⟨111⟩ SILICON SAMPLE AND ITS SUBSTRATE DURING A PHOSPHORUS ION IMPLANTATION AT MEAN ENERGY. Bisaro, R.; Biet, G. (Thomson-CSF, Domaine de Corbeville, 91 - Orsay (France)). Compt. Rend., Ser. A, B; 279: No. 5, 129-130(29 Jul 1974). (In French).

The change in disorder induced in a silicon ⟨111⟩ target by phosphorus ion implantation is explained in terms of the ion flux. (FR)

1548 INTERSTITIAL DEFECTS IN IRRADIATED ALKALI HALIDES. Catlow, C. R. A.; Diller, K. M.; Norgett, M. J. (Oxford Univ.). J. Phys., C (London); 8: No. 3, K34-L36(7 Feb 1975).

Calculations were made comparing the energy of various atomic and molecular halogen defects in NaCl. It is found that it is energetically possible for the H centres produced by irradiation to form a defect comprising a Cl_2 molecule in a divacancy if the adjacent ions are removed to a surface or dislocation. The observed perfect interstitial loops may thus form exothermically from H centres. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

1549 (NTO-I-0273) SS NUCLEAR MATERIALS MANAGEMENT MANUAL. Bybee, R. S. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 7 Jun 1967. 38p. Dep. NTIS $5.00.

Guidelines and procedures are provided for safety, security, and accountability control of source and special (SS) nuclear materials. The manual is intended to give the basic reference material from which the following can be established: an accountability system, consistent with monetary value, which will immediately disclose the misappropriation or other loss of SS materials; a recording, measurement and reporting system for initial receipts, internal transfers, shipments, storage, and inventories which will promptly provide current and accurate information on the disposition and availability of SS materials; forecasting and procurement policy for requests involving SS Materials; and safety and security control measures for SS Materials. (auth)

1550 INSTRUMENTAL SAFEGUARDS IN NUCLEAR POWER STATION. Boedege, R. (Kernkraftwerk Lingen G.m.b.H., Darme/Lingen (F. R. Germany)). At. Strom; 20: No. 11/12, 115-121(Nov 1974). (In German).

After a short analysis of the treaties committing the European Communities, some details, important for their application, are discussed. The system of instrumental safeguards are considered and different procedures are evaluated, based on the indications concerning the surveillance of the German prototype nuclear power station. (auth)

1551 SAFEGUARDING OF NUCLEAR FUELS. Brenner, L. M.; Bartels, W. C. (Div. of Nuclear Safeguards and Security, Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 35-37 (Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The USA safeguards research and development program is reviewed with special emphasis on nondestructive measurement techniques for material accountability. (TFD)

1552 ON-LINE MEASUREMENT OF THE ISOTOPIC COMPOSITION OF URANIUM IN UF_6. Stieff, L. R. (Arms Control and Disarmament Agency, Washington, DC); Woltz, F. E.; Reilly, T. D. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 731-733(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

An in-line monitor used initially to continuously measure the ^{235}U enrichment in liquid UF_6 at the Portsmouth Gaseous Diffusion Plant has recently been recalibrated to provide continuous measurements of both ^{234}U and ^{235}U. The instrument using both a gamma-ray detector for ^{235}U and a neutron detector for ^{234}U has produced data that is in good agreement with precision mass spectrometric measurements made on related samples of UF_6. Studies now in process suggest that the use of such minor isotope data will provide the safeguards inspector with a useful additional tool in his efforts to independently verify the operations and nuclear material accountancy records of an isotope separation plant. The preliminary results indicate that an instrument originally developed to meet the operational problems of the plant can also make a significant contribution to the difficult problems of providing effective safeguards for an enrichment plant. (auth)

1553 GAMMA-RAY SPECTROMETRY FOR CALORIMETRIC ASSAY OF PLUTONIUM FUELS. Haas, F. X.; Strohm, W. W. (Monsanto Research Corp., Miamisburg, OH). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 734-738(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

High resolution gamma-ray measurements of plutonium isotopic and americium-241 concentrations are being used with a calorimetric measurement of heat from radioactive decay for a precise and accurate nondestructive assay of plutonium. The technique and results of measurements are presented. Requirements for Ge(Li) detectors, data acquisition and reduction systems are described. (auth)

1554 AUTOMATED NONDESTRUCTIVE ASSAY INSTRUMENTATION FOR NUCLEAR MATERIALS SAFEGUARDS. East, L. V.; Martin, E. R.; Atwell, T. L.; Augustson, R. H.; Menlove, H. O. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 739-743(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Four systems developed at the Los Alamos Scientific Laboratory for nondestructive analysis of nuclear fuel materials are described. These systems utilize either mini-computers or a programmable calculator for measurement control and data analysis, and are typical of a variety of automated measurement systems developed for nuclear materials safeguards applications. The systems include: (1) a passive gamma-ray scanning system for low-density scrap and waste; (2) an active neutron interrogation system for bulk samples of fuel feed material; (3) an active neutron system for assaying irradiated test reactor fuel material; and (4) a multienergy active neutron assay system being developed for high-precision assay of small samples. (auth)

1555 FUEL ROD SCANNER FOR QUALITY CONTROL AND SAFEGUARDS. Bramblett, R. L. (IRT Corp., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 744-747(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

An automated fuel rod scanner which uses activation by ^{252}Cf neutrons is described. This scanner is being used to measure the uniformity of fuel loading and the total fissile content of both UO_2 and mixed oxide fuel rods. Multiple detectors with high sensitivity are used to reduce the ^{252}Cf source strength requirement. Excellent electronic stability is attained by the use of current, rather than pulse electronics. An important feature of the scanner is its on-line minicomputer, which allows a high throughput of fuel rods using a small operating staff. (auth)

1556 NONDESTRUCTIVE ASSAY INSTRUMENTATION FOR USE BY INSPECTORS. Walker, A. C. (Atomic Energy Commission, Richland, WA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 748-751(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The application of nondestructive assay (NDA) instrumentation during nuclear material safeguards inspections by the USAEC Richland Operations Office (Hanford) is described. The problems and constraints of NDA instrument use are discussed from an inspector's viewpoint. New and modified NDA instrumentation is suggested which would provide improved measurement verification during safeguards inspections. (auth)

1557 INSTRUMENTATION FOR REAL-TIME MATERIALS CONTROL. Shea, T. E. (Nuclear Regulatory Commission, Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 752-758(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A concept to improve the current safeguards accountability system is described. The concept, identified by the acronym RETIMAC (Real-Time Material Control), incorporates extensive in-line instrumentation, access and transfer controls, time-sequenced state estimators, and real-time computerized data acquisition and analysis. In the RETIMAC concept, plants would be partitioned into a series of independent process stages. Access and material transfer between stages would be controlled or monitored by a central computer. Information would be analyzed for material control at the process stage level. Additional tests for consistency between stages, for overall plant performance, and for consistency throughout the industry would complete the theft detection coverage. (TFD)

Disposal and Storage

Refer also to abstracts 186–188, 194, 741, and 1096.

1558 (ARH-2960(Vol.1)) STORAGE FEE ANALYSIS FOR A RETRIEVABLE SURFACE STORAGE FACILITY. Field, B. B.; Rosnick, C. K. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-2130. 115p. Dep. NTIS $8.75.

Conceptual design studies are in progress for a Water Basin Concept (WBC) and an alternative Sealed Storage Cask Concept (SSCC) of a Retrievable Surface Storage Facility (RSSF) intended as a Federal government facility for storing high-level radioactive wastes until a permanent disposal method is established. The RSSF will be a man-made facility with a design life of at least

100 y, and will have capacity to store all of the high-level waste from the reprocessing of nuclear power plant spent fuels generated by the industry through the year 2000. This report is a basic version of ARH-2746, "Retrievable Surface Storage Facility, Water Basin Concept, User Charge Analysis." It is concerned with the issue of establishing a fee to cover the cost of storing nuclear wastes both in the RSSF and at the subsequent disposal facility. (TFD)

1559 (ARH-2960(Vol.2)) STORAGE FEE ANALYSIS FOR A RETRIEVABLE SURFACE STORAGE FACILITY. Field, B. B.; Rosnick, C. K. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-2130. 224p. Dep. NTIS $14.25.

Computer print-outs for cases 1 through 22 for the water basin and sealed storage cask concept of a Retrievable Surface Storage Facility (RSSF) are presented. (TFD)

1560 (KURRI-TR-121) STORAGE OF RADIOACTIVE WASTE IN THE GROUND. 1. Tsutsui, T.; Katsurayama, K.; Nishimaki, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Nov. 1973. 10p. (In Japanese).

The behavior of radionuclides in the ground was investigated in order to determine the safety of underground storage of radioactive wastes. For the purpose of this investigation, many experiments (field and laboratory) were made. The results of laboratory experiments are detailed, using ^{131}I, ^{51}Cr, ^{54}Mn, ^{60}Co, ^{137}Cs and ^{59}Fe. The migration of each of these radionuclides was investigated, as each was transported by ground water through columns packed with soil. The migration of each radionuclide was very slow compared to that of ground water and is predicted by theory governing the movement of these radionuclides. (auth)

1561 (PB-237741) RADIOACTIVE WASTE DISPOSAL ACTIVITIES IN THE VICINITY OF THE FARALLON ISLANDS. Final Report. (Interstate Electronics Corp., Anaheim, Calif. (USA)). Nov 1974. Contract EPA-68-01-0796. 44p. (IEC-455-OC-067). NTIS $3.75.

Results are presented of a study undertaken to search for and consolidate historic information regarding the disposal or radioactive waste at locations near the Farallon Islands in the waters of the Pacific Ocean. Information includes an inventory of the quantities of materials dumped, approximate locations of the three known sites, a summary of general oceanographic studies in the area, and a bibliography of related documents. (GRA)

1562 (WASH-1539(Draft)) MANAGEMENT OF COMMERCIAL HIGH-LEVEL AND TRANSURANIUM-CONTAMINATED RADIOACTIVE WASTES. Environmental Statement. (USAEC, Washington, D. C.). Sep 1974. 613p. Dep. NTIS $33.75.

This Draft Environmental Statement is issued to assess the environmental impact of the AEC's program to manage commercial high-level and transuranium-contaminated radioactive wastes. These are the types of commercial radioactive wastes for which AEC custody is required by present or anticipated regulations. The program consists of three basic parts: development of a Retrievable Surface Storage Facility (RSSF) for commercial high-level waste, using existing technology; evaluating geological formations and sites for the development of a Geological Disposal Pilot Plant (GDPP) which would lead to permanent disposal; and providing retrievable storage for the transuranium-contaminated waste pending availability of permanent disposal. Consideration has been given to all environmental aspects of the program, using waste generation projections through the year 2000. Radiological and other impacts of implementing the program are expected to be minimal, but will be discussed in further environmental statements which will support budget actions for specific repositories. The alternatives discussed in this Draft Environmental Statement are presented. (auth)

1563 CONCEPTUAL DESIGN STUDIES FOR INTERMEDIATE STORAGE OF HIGH-LEVEL RADIOACTIVE WASTE. van den Bossche, A.; Endriss, H. J.; Wingender, H. J.; Witte, H. Trans. Amer. Nucl. Soc.; 20: 686-689(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1564 MANAGEMENT OF RADIOACTIVE WASTES. Lennemann, W. L.; Parker, H. E.; West, P. J. Trans. Amer. Nucl. Soc.; 20: 690(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1565 INTERACTION BETWEEN PROCESSING METHOD AND RADIOACTIVE WASTE BURIAL SITE. Sousselier, Y. Trans. Amer. Nucl. Soc.; 20: 691-692(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1566 PLUTONIUM CRITICALITY CONSIDERATIONS IN REPROCESSING WASTES AND CONTAMINATED SOILS. Carter, R. D. Trans. Amer. Nucl. Soc.; 20: 692-693(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1567 SEA DISPOSAL OF PACKAGED RADIOACTIVE WASTES. Olivier, J. P. Trans. Amer. Nucl. Soc.; 20: 693-695 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1568 HYDROGEN FROM NUCLEAR WASTES. Bettinali, C. Trans. Amer. Nucl. Soc.; 20: 793-795(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

Handling Equipment and Procedures

Refer also to abstracts 372, 387, 388, 390, 877, 963, and 1645.

1569 (WANL-TMI-1405(Rev. 1)) CRITICALITY HAZARDS CONTROL PROCEDURE, HIGH TEMPERATURE TEST ROOM, ENGINEERING MECHANICS LABORATORY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1966. 35p. Dep. NTIS $4.75.

The procedure for maintaining adequate criticality control within the high temperature test room is described. This room is used for the mechanical testing of fueled elements and clusters with U loadings up to 900 mg/cc at temperatures from room to 5000°F. (LCL)

1570 (WANL-TMI-1405(Rev.3)) CRITICALITY HAZARDS CONTROL PROCEDURE, HIGH TEMPERATURE TEST ROOM, ENGINEERING MECHANICS LABORATORY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1967. 42p. Dep. NTIS $5.25.

The procedure for maintaining adequate criticality control within the high temperature test room is described. This room is used for the mechanical testing of fueled elements and clusters with U loadings up to 900 mg/cc at temperatures from room to 5000°F. (LCL)

1571 (WANL-TMI-1405(Rev.4)) CRITICALITY HAZARDS CONTROL PROCEDURE, HIGH TEMPERATURE TEST ROOM, ENGINEERING MECHANICS LABORATORY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1967. 44p. Dep. NTIS $5.25.

The procedure for maintaining adequate criticality control within the high temperature test room is described. This room is used for the mechanical testing of fueled elements and clusters with U loadings up to 900 mg/cc at temperatures from room to 5000°F. (LCL)

1572 (WANL-TMI-1405(Rev.5)) CRITICALITY HAZARDS CONTROL PROCEDURE, HIGH TEMPERATURE TEST ROOM, ENGINEERING MECHANICS LABORATORY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1968. 44p. Dep. NTIS $5.75.

The procedure for maintaining adequate criticality control within the high temperature test room is described. This room is used for the mechanical testing of fueled elements and clusters with U loadings up to 900 mg/cc at temperatures from room to 5000°F. (LCL)

1573 (WANL-TMI-1975) QUALIFICATION TEST OF A SHIPPING CONTAINER. Sinwell, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 May 1969. 8p. Dep. NTIS $4.00.

Thirty-foot and 40-in. drop tests performed on 55-gal drum used to contain plastic bottles for shipping radioactive materials are described. Damage to the drum internal housing and/or plastic bottle was noted and a redesign of the internal housing was recommended. (LCL)

1574 DATA ACQUISITION AND PROCESS CONTROL SYSTEM FOR THE HOT FUEL EXAMINATION FACILITY. Ramsthaler, J. A.; Lau, L. D.; Just, F. H. (Argonne National Lab., Idaho Falls). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 536-539(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A data acquisition and process control system has been developed to control the remote examination of reactor fuel elements in a hot cell. The computer system, positioning stages, CAMAC controls, and detection equipment are described. One of the examinations performed, precision gamma scanning, illustrates the use of this system. The development of both hardware and software, the logic for controlling the examination, and the utilization of the CAMAC standard are discussed. Expansion of this system

to include several new examinations will determine whether or not further automation of the facilities is feasible. (auth)

1575 CAMAC SOFTWARE FOR THE HOT FUEL EXAMINATION FACILITY REAL-TIME COMPUTER SYSTEM. Lau, L. D.; Ramsthaler, J. A.; Just, F. H. (Argonne National Lab., Idaho Falls). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 540-542(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Software based on the CAMAC standards has been developed for a real-time data acquisition and process control system. The system is used to control the examination of irradiated fuel elements. Employing CAMAC in software has resulted in the development of a standard method of addressing the acquisition and control hardware. A description of a subroutine that outputs command words to the CAMAC system, checks for transmission errors, and checks for completion of the CAMAC handshake is presented. Use of this subroutine decreases programming time and training time due to system expansion or changes. Modularization of software through the use of subroutines has simplified programming of the software system. (auth)

1576 PLUTONIUM STORAGE STUDY. Hueda, A. U.; Sanchez, F. R. Trans. Amer. Nucl. Soc.; 20: 618-620(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1577 A STORAGE AND EXTRACTION DEVICE WITH AUTOMATIC INDEXING FOR FLASKS CONTAINING, IN PARTICULAR, RADIOACTIVE PRODUCTS. Leroy, M.; Bruneau, J.; Cohen, Y.; Merlin, L. (to CEA). French Patent 2,204,550/A/. 27 Oct 1972. 10p. (In French).

The device is characterized in that it comprises a chamber for storing a flask, containing two endless chains connected by tulip-shaped members, the heads of which rise above the upper chain and contain each a flask receiving socket, a manipulator chamber located above said storage chamber and connected with a vertical shaft, a cable mounted in said shaft, the cable being connected to a winch-motor and carrying a yoke at one end acting as a backing member for said sockets, a motor for driving the chains and a decimal coding system connected to that motor. (FR)

Transportation

Refer also to abstracts 210 and 372.

1578 (B-164105) OPPORTUNITY FOR AEC TO IMPROVE ITS PROCEDURES FOR MAKING SURE THAT CONTAINERS USED FOR TRANSPORTING RADIOACTIVE MATERIALS ARE SAFE. Report to the Congress by the Comptroller General of the United States. Staats, E. B. (General Accounting Office, Washington, D.C. (USA)). 31 Jul 1973. 36p. U. S. General Accounting Office, Washington, DC $1.00

The report evaluates ERDA's policies, procedures, and practices for insuring that containers for transporting hazardous radioactive materials are properly designed, fabricated, and used. Actions that can be taken to improve the safety of the shipping containers are recommended. (TFD)

1579 (HW-69561(Rev.)) CONSEQUENCES OF ACCIDENTAL RELEASES DURING SHIPMENTS OF RADIOACTIVE CESIUM AND STRONTIUM. Watson, E. C.; Junkins, R. L.; Fuquay, J. J.; Zahn, L. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1961. Contract AT(45-1)-1350. 74p. Dep. NTIS $6.75.

Declassified 6 Feb 1974.

The shipment of large quantities of radionuclides from Richland, Washington (Hanford) to Oak Ridge, Tennessee involves the possibility of an accidental release of these materials. The consequences of radiocesium and radiostrontium releases and the associated potential damages to man and his environment are discussed. Previous estimates of potential damage for shipments involving ^{90}Sr and ^{137}Cs (shipped as cations adsorbed on an ion exchange medium) have been published. However, recent experimental data, particularly on the volatility of ^{137}Cs when adsorbed as a cation, have made it possible to revise these estimates. The consequences of accidental release resulting from shipping ^{90}Sr as a carbonate are included. This report supersedes HW-69461, "Hazard Analysis for Cesium Shipments" (May 11 issue) and HW-68899, "Maximum Liability Evaluation, Strontium and Cesium Shipments on Decalso Media." (auth)

1580 (PTB-FMRB-58) METHOD FOR THE SIMULATION OF A LATTICE-SHAPED REFLECTING ARRAY OF IDENTICAL FUEL CONTAINERS USING THE MONTE CARLO COMPUTER PROGRAM MORSE-K. Schweer, H. H. (Physikalisch-Technische Bundesanstalt, Braunschweig (F.R. Germany). Forschungs- und Messreaktor). Nov 1974. 22p. (In German). Dep. NTIS (US Sales Only) $4.25.

Two versions of a procedure are described for a simple evaluation of the reactivity of an array of identical containers used for the transport or the storage of nuclear material. By changing the flight paths of the neutrons at distinct boundaries of one container the whole reflected system of the containers can be simulated. This procedure reduces the complexity of the geometrical description of the array without losing any details of the materials and the size of the containers. Further, computer time and the field length of the program are reduced. Also, it is possible to change the number of containers of the array by only changing one data card. (auth)

1581 (WANL-TME-1973) EVALUATION OF NERVA SCRAP SHIPPING CONTAINERS. Scarano, R. A.; Brown, R. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). (Astronuclear Lab.). Oct 1969. 42p. Dep. NTIS $5.25.

The NERVA Scrap Shipping Container gives Westinghouse Astronuclear Laboratory (WANL) a means of transporting process waste, generated by the NERVA program, for uranium recovery. The allowable limits per container are 5 kg containing ^{235}U in the form of NERVA fuel scrap or 600 grams containing ^{235}U in the form of leaching operation waste. Depending on the amount of containers to be transported, WANL has the option of shipping the containers as a Fissile Class II or Fissile Class III shipment. The minimum Transport Index per container in a Fissile Class II shipment is 1.0. The maximum number of containers in a Fissile Class II shipment is 100. (auth)

1582 (WANL-TMI-1812) NR-1 REACTOR SHIPPING CONTAINER DESIGN REQUIREMENTS. Price, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1967. 22p. Dep. NTIS $4.25.

Specifications for the design, reliability, and maintenance of the shipping container for the NR-1 reactor are presented. (LCL)

1583 (WANL-TR-116) NRX-A SHIPPING CONTAINER DESIGN REPORT. Ulrich, J. M.; Kraus, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1963. 110p. Dep. NTIS $8.50.

Declassified 13 Jul 1971.

Shipping container design is the technology of preparing an item for shipment in such a manner as to eliminate damage from the environmental conditions encountered during shipment. The problem of developing a shipping container for the NRX-A reactors is discussed. The formulation of the design criteria and the special requirements developed for the container were based on design parameters defined for the reactor, Westinghouse experimental data, analysis, engineering judgment and current literature. The design, fabrication and testing of the initial container was performed by the Applied Design Company, Tonawanda, New York. In a series of tests, it was shown that the container fully satisfies all the design criteria and special requirements. (auth)

1584 NEW STANDARD SERIES OF PACKAGINGS FOR LOADS UP TO 40,000 CURIES OF COBALT-60 OR EQUIVALENT. Dixon, F. E. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Int. J. Radiat. Eng.; 1: No. 6, 537-548(Dec 1971).

From conference on lead shielding and nuclear safety; London, Eng. (25 Mar 1969).

A range of containers is described which fits most of the needs of a commercial isotope transport organization, and which consists in the main of "type A" and "type B" packagings designed as a series rather than as an adaptation of existing pots. New methods of thermal insulation and mechanical protection (based on AERE-M 2086) are included. This series does not include any special purpose containers. (auth)

1585 DYNAMICS OF IMPACT IN DROP TESTS OF PACKAGING. Langhaar, J. W. Trans. Amer. Nucl. Soc.; 20: 623-624 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1586 TESTING OF LARGE, OBSOLETE SHIPPING CASKS. Shappert, L. B.; Evans, J. H. Trans. Amer. Nucl. Soc.; 20: 624-627(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1587 RADIOACTIVE TRANSPORTATION SAFETY: NOW AND IN THE FUTURE. Sousselier, Y.; Cohendy, G. Trans. Amer. Nucl. Soc.; 20: 627(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1588 PACKING FOR RADIOACTIVE MATERIALS IN FRANCE. Labrousse, M.; Remy, J.; Lucas, H. Trans. Amer. Nucl. Soc.; 20: 627-629(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

1589 TRANSPORT OF IRRADIATED FUEL FROM EUROPEAN LIGHT-WATER REACTORS. Curtis, H. W. Trans. Amer. Nucl. Soc.; 20: 632-633(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 329.

1590 (AD/A-000816) GIGAWATT MICROWAVE EMISSION FROM AN INTENSE RELATIVISTIC ELECTRON BEAM. Final Report. Granatstein, V. L.; Herndon, M.; Nation, J. A. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 15p. (NRL-MR-2856). NTIS $3.25.

Microwave generation experiments were carried out on a multi-megavolt electron accelerator (3.3 MV, 80 kA). X-band microwave power as high as about 1 GW was measured. Results are compared with a non-linear theory of unstable resonant interaction between a TE waveguide mode of the electron drift tube and an electron cyclotron wave on the beam. (GRA)

1591 (BNL-19825) SEARCH FOR THE "ABNORMAL NUCLEAR STATE" HEAVY, A greater than 200, ION ACCELERATION IN THE AGS. Prelec, K.; van Steenbergen, A. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-55). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Recent theoretical work speculates on the existence of abnormal states of matter which could possibly be created as a result of collisions of super energetic heavy nuclei. For this reason the possibility of acceleration of heavy ions with mass number A greater than 200 to kinetic energies of 1 less than T/sub n/ less than 10 GeV/nucleon has been studied and found to be feasible without modification of the AGS vacuum and rf systems by using a fast cycling synchrotron as a booster ring. This booster is required in order to obtain the fully stripped ion state, since partially stripped heavy ion acceleration in a slow rise time accelerator is impractical because of extreme vacuum requirements. The fast cycling feature of the booster is essential in reducing transmission losses associated with electron capture or loss during acceleration and beneficial in increasing the final beam intensity. (auth)

1592 (BNL-19876) ADVANCES IN ELECTROSTATIC ACCELERATORS. Wegner, H. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 10p. (CONF-750335-43). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Advances in the design and performance of electrostatic accelerators since 1969 are reviewed with special emphasis on the "forefront" accelerators that are currently leading in voltage capability. A comparison of the acceleration tube design offered by the National Electrostatics Corporation and the High Voltage Engineering Corporation is also made. Other methods of increasing heavy ion energy by means of dual foil stripping are discussed as well as the performance of a newly developed sputter ion source for the production of negative heavy ions with reliability and flexibility that greatly exceeds all other present systems. Finally, new developments in terms of both booster systems and very high voltage electrostatic accelerators (25 to 60 MV) are discussed. (auth)

1593 (CONF-750335-41) USES OF ACCELERATORS IN ENERGY R AND D. Saltmarsh, M. J. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.00

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

At many laboratories an increasing emphasis is being placed on energy-related research, often at the expense of more basic programs. The effects of this change can be clearly seen at accelerator laboratories, where tools traditionally reserved for nuclear and particle physicists are being applied in areas such as radiation damage, nuclear waste management, and materials science. The success of accelerator-based work in these fields is reflected by the increasing interest in proposals for new facilities devoted entirely to applied programs. Current proposals include various forms of intense neutron sources for fusion-related work, synchrotron x-ray sources for materials studies, and even the use of accelerators for large-scale nuclear waste disposal. (45 references) (auth)

1594 (COO-1779-155) ANNUAL REPORT, JULY 1, 1973–JULY 1, 1974. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Sep 1974. 173p. Dep. NTIS $11.75.

This document encompasses all nuclear programs of the MSU Cyclotron Laboratory. It contains brief descriptions of work in progress, abstracts of papers delivered at meetings, abstracts of papers in press, title pages of published articles, and thesis titles. The work in progress is divided into the following sections: exotic reactions and mass measurements, inelastic scattering, transfer reactions, reaction mechanisms, neutron work, shell-model calculations, nuclear astrophysics, giant resonances, nuclear gamma and beta spectroscopy, accelerator design, and technical developments. Twenty-nine of the papers, including significant amounts of information, are title listed separately. (RWR)

For title listings of individual papers see: 322, 1595, 1925, 1935–1937, 1954–1958, 1975–1979, 1996–1999, 2012–2016, 2049–2051, and 2062.

1595 (COO-1779-155, pp 75-76) DESIGN STUDIES OF SUPERCONDUCTING HEAVY ION CYCLOTRONS. Blosser, H. G.; Gordon, M. M.; Johnson, D. A. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1596 (DESY-L-Ueb-184) POSSIBLE WAYS OF ACHIEVING CYCLIC ACCELERATION OF ELECTRONS WITHOUT RADIATION. Vorobev, A. A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Apr 1974. 10p. (In German). INIS.

17 refs. Published in Izv. Vyssh. Uchebn. Zaved, Fiz. no. 10 (1973) p. 10-15.

The synchrotron radiation limits the achievable energies for ultrarelativistic particles in cyclic accelerators. The radiation can be essentially attenuated, and even eliminated in the ideal case in cyclical particle acceleration, e.g., in the case of a particle moving on the trajectory corresponding to the ground state or in the case of interference of radiation from coherent sources whose number is increasing proportional to the third power of the energy. Theoretically, for electrons with an energy of 10^9 eV, 10^{10} polarized electrons uniformly distributed on the trajectory will suffice to completely eliminate the radiation. Other possible models are also discussed. (GE)

1597 (LA-UR-75-453) LIGHT ION LINACS FOR MEDICAL APPLICATIONS. Bradbury, J. N.; Knapp, E. A.; Nagle, D. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 4p. (CONF-750335-23). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Recent advances in linear accelerator technology point to the feasibility of designing and developing practical medical linacs for producing protons, neutrons, or pi mesons for the radiation therapy of cancer. Additional uses of such linacs could include radioisotope production and charged particle radiography. For widespread utilization medical linacs must exhibit reasonable cost, compactness, reliability, and simplicity of operation. Possible extensions of current accelerator technology which might provide these characteristics are discussed in connection with linac design, fabrication techniques, materials, power sources, injectors, and particle collection and delivery systems. Parameters for a medical proton linac for producing pions are listed. (auth)

1598 (LBL-3366) PERFORMANCE OF THE BEVALAC. Barale, J.; Force, R.; Grunder, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 5p. (CONF-750335-20). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The performance of the Bevalac is reported. The Bevalac uses the LBL SuperHILAC as the heavy ion injector to the Bevatron. Ion species up to ^{40}A have been accelerated to energies of 1.9 GeV/A at modest intensity. Neon has been accelerated to 2.1 GeV/A at an intensity of $4 \cdot 10^{10}$ particles per pulse. The modifications to the SuperHILAC and Bevatron are briefly reviewed and the computer control system is described. Results of the first phase of operation and plans for further improvements are reported. (auth)

1599 ONE POSSIBILITY OF MORE EFFECTIVE UTILIZATION OF BEAMS FROM LINEAR ELECTRON ACCELERATORS. Lazareva, L. E. (Nuclear Research Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 7, 221-222(5 Oct 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red; 20: No. 7, 486-488(5 Oct 1974).

A proposal for increased accelerator utilization efficiency is presented. Since all the accelerating sections are similar in

structure, the electron beam from the injector section can be introduced into any section along the accelerator, i.e., any group of sections can work as an autonomous accelerator. If additional injectors are installed to be able to inject electrons into any ith group of sections, separated by magnetic sections for beam extraction, then the accelerator can operate as several independent accelerators. The electron beams obtained simultaneously from different sections of the accelerator can in this case have maximum intensity which does not depend on the operating conditions of any other part of the accelerator. (WHK)

1600 DESIGN PROBLEMS OF ELECTRON ACCELERATORS FOR HIGH VOLTAGE ELECTRON MICROSCOPES. Reinhold, G. (Emile Haefely and Co. Ltd., Basel). Int. J. Radiat. Eng.; 1: No. 2, 105-114(Aug 1971).

From first national conference on current developments in high voltage electron microscopy; Monroeville, PA (17 Jun 1969).

Available electromagnetic high-voltage generators for electron microscopy are discussed, stressing the particular requirements such as the absence of vibrations and highly stable accelerating voltages during the exposure time. Design principles involved in the attainment of these requirements and engineering details of the respective component systems are presented. Attention is aimed at elimination of stray ac voltages from the accelerating tube and divider, and at special electron gun designs with movable anodes for pressurized accelerators, based on cascade generators. Minimization of electron beam deflection and elimination of microdischarges are also considered. (auth)

1601 RADIATION DYNAMICS, INC.: ACCELERATOR MANUFACTURER. Morganstern, K. H. Int. J. Radiat. Eng.; 1: No. 1, 61-68(Jul 1971).

The activities of Radiation Dynamics, Inc., a manufacturer of high voltage, high current electron accelerators, are described. The two major lines of equipment, serving the radiation processing industry, are the Dynamitron and the Dynacote. Details are given on the respective technical characteristics and performance rates. Applications and customers are presented. (auth)

Auxiliaries and Components

Refer also to abstract 595.

1602 (ANL/HEP-75-07) SUPERCONDUCTING MAGNETS AND CRYOGENICS. Purcell, J. R. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-ENG-38. 7p. (CONF-750335-40). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Several significant superconducting beam line magnet systems are being constructed in the U. S. These will demonstrate the practicability of superconductors in beam lines. It is now time to consider some of the more subtle engineering problems associated with these magnets in order to assure a "next generation" of highly usable magnets. This paper presents some engineering approaches to better magnets for the future. (auth)

1603 (BNL-19575) HIGH FIELD SUPERCONDUCTING MAGNETS FOR ACCELERATORS AND PARTICLE BEAMS. Allinger, J.; Danby, G.; Jackson, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 8p. (CONF-740957-33). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

Experience in designing precision superconducting magnets for fields up to 60 kG is described. Realizable construction tolerances and their impact on field accuracy are discussed. For dipole fields up to 60 kG or more, rectangular coil window frame type magnets are compared with circular or elliptical coil designs. In all cases, the same superconductor current density versus maximum field performance is assumed. The comparison will include field quality and correction required as a function of aperture size, stored energy, ampere turns required, and overall magnet size. In quadrupole design the impact of the allowed superconductor current density being roughly inversely proportional to peak field is severe. For gradients up to one Tesla/cm or greater, similar comparisons for different types of quadrupole construction are made. (auth)

1604 (BNL-19836) AGS BEAM LOSS MONITORING SYSTEM. Levine, G. S.; Balsamo, J. C. Jr. (Brookhaven National Lab., Upton, N. Y. (USA)). 1971. 3p. (CONF-750303-59). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The usefulness of a beam loss monitoring system in diverse aspects of accelerator operation is documented with a variety of examples. (auth)

1605 (CONF-750335-22) ULTRA-SHORT PULSES OF HEAVY IONS. Bollinger, L. M.; Khoe, T. K.; Lynch, F. J. (Argonne National Lab., Ill. (USA)). 1975. 5p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The bunching requirements for a heavy-ion tandem-linac accelerator are defined and a bunching system to satisfy these requirements is outlined. This discussion introduces an experiment on the bunching of 45 MeV ^{16}O ions by means of a lambda/2 superconducting-helix resonator. The measured ion-bunch width is 64 psec, a value dominated by the resolution width of the ion detector. By correcting for the detector-resolution width one infers that the ion bunch itself is less than 40 psec wide. (auth)

1606 (DESY-L-Ueb-188) CONCRETE SHIELDING FOR ELECTRON ACCELERATORS FOR 0.5-10 MeV. Tsovbun, V. I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). 1974. 8p. (In German). INIS.

2 figs.; 4 tabs.; 9 refs. Translated from JINR-P-16-7834. Available from ZAED.

Extensive calculations for shielding made of common concrete for electron accelerators with energies of 0.5; 1; 1.5; 2; 3; 4; 5; 6; 7; 8; 9; and 10 MeV have been carried out according to the "competing lines" method. The angle of incidence of radiation was chosen from 0 to 70° in divisions of 10°. The calculations were carried out for four variants of the set-up of shielding and target to one another. The calculated radiation attenuation factor reached 10^{10}. (GE)

1607 (IFVE-ETO-74-13) COOLING SYSTEM FOR ACCELERATOR RING MAGNET COILS. Chumakov, B. I.; Vakurin, E. V.; Moskvitin, B. A.; Fartukov, S. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A cooling system for the Al magnet coils with demineralized water ($\rho \geq 0.6 \times 10^4$ ohm/cm) as a cooling flux is described. The system has arrangements for water supply, for its cooling and demineralization as well as devices to perform control over general conditions of the cooling flow. A diagram and results on chemical rinsing of the system are presented. Operating experience with the cooling system exhibited reliability of the system mobility in time of achieving operating conditions after a shut down and to controlled hydraulic and chemical conditions. (auth)

1608 (INIS-mf-1659) RING COUPLED ACCELERATING STRUCTURE FOR USE IN ELECTRON LINEAR ACCELERATORS. Manca, J. J. (Alberta Univ., Edmonton (Canada). Dept. of Electrical Engineering). Jun 1972. 43p. INIS.

There are many applications of electron accelerators in medicine and physics as well as in industry. These machines for general applications should be as compact as possible. The basic part of a small compact linear accelerator is its accelerating structure. A study of the axially symmetric microwave resonator for the purpose of particle acceleration was done at this Department and the conclusion was drawn that a so called ring coupled microwave structure should be used for a design of a compact electron linear accelerator. The structure has been completed from the cavities resonating at the frequency $f_r = 2865$ MHz. A biperiodic structure was chosen because it combines the property of π mode, high shunt impedance and at the same time the feature of the $\pi/2$ mode, quite insensitive to beam loading. After the accelerating structure was tuned and the cold tests showed its good characteristics, an electron gun was designed and the linear accelerator was completed. The output energy of the accelerated electrons was estimated at E = 2 to 4 MeV. (auth)

1609 (JINR-P13-8066) STABILIZED CURRENT SOURCE UP TO 3200 A FOR SUPERCONDUCTING SOLENOID. Bychkov, N. S.; Lachinov, V. M.; Popov, A. A.; Khabarov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The stabilized source of current SIT-3200 of the maximum current up to 3200 A, intended for feeding the superconducting solenoid 3200 A of an accelerating section of a ringtron (Department of New Methods of Acceleration, JINR) is described. Six hundred of transistors SPS 600 are used to operate the current. Operational integral amplifiers are used in the circuit. Current velocity (0.5 to 20 A/sec) is regulated by means of a special circuit of a digital integrator. The accuracy of the current sta-

bilization for values greater than 1000 A is better than 10^{-3}. (auth)

1610 (LA-tr-75-11) MEASUREMENT OF BEAM EMITTANCES AND BEAM CENTERING IN THE 800-MeV MEASUREMENT LINE OF THE PS BOOSTER. Metzger, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 21 Jan 1975. Translation by H. Koziol of CERN/SI/Int. DL/69-10. 17p. Dep. NTIS $4.00.

The principles of emittance measurement on a primary beam based on measuring beam profiles at three locations along a drift space are discussed. This method is used to measure the emittance and central trajectories of each of the four recombined beams in the drift space between TS-Q4 and the beam dump at the CERN PS. These measurements are the basis for the fine tuning of the recombination line. (WHK)

1611 (LA-UR-75-403) PULSED BEAM CHOPPER FOR LAMPF. Bentley, R. F.; Lunsford, J. S.; Lawrence, G. P. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 4p. (CONF-750335-21). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

A pulsed beam chopper has been designed and tested for use on the 750 keV proton injector transport line of LAMPF. The deflection structure, which is 1 m long, is similar to the traveling wave beam deflector in a high speed oscilloscope. The proton beam travels between two deflection "plates" each consisting of the closely spaced turns of a helical delay line. A 5 ns long positive pulse on one helix with a simultaneous negative pulse on the other helix creates a transverse electric field in the beam region which travels with the beam. The longitudinal velocity of the electric field is matched to the proton beam velocity (approximately 1 cm/ns) by the pitch of the helices. This scheme allows the 5 ns (5 cm) long "micropulses" of LAMPF to be chopped into or out of the linac with 1 ns transition times. This method avoids the constraints of resonant chopping systems and will permit completely arbitrary patterns of LAMPF micropulses to be selected and accelerated. One exotic application is the generation of pseudorandom pulse sequences for neutron time-of-flight measurements. (auth)

1612 (LA-UR-75-426) OPERATING EXPERIENCE WITH LAMPF MAIN BEAM LINES INSTRUMENTATION AND CONTROL SYSTEM. van Dyck, O. B.; Harvey, A.; Howard, H. H.; Roeder, D. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 12 Mar 1975. Contract W-7405-ENG-36. 5p. (CONF-750335-42). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Instrumentation and control (I and C) for the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) main beam line is based upon central computer control through remote stations which provide input and output to most devices. Operating experience shows that the ability of the computer to give high-quality graphical presentation of the measurements enhances operator performance and instrument usefulness. Experience also shows that operator efficiency degrades rapidly with increasing instrument response time, that is, with increasing delay between the time a control is changed and the result can be observed. For this reason, instrumentation upgrade includes speeding up data acquisition and display times to under 10 s. Similarly, television-viewed phosphors are being retained where possible since their instantaneous response is very useful. Other upgrading of the instrumentation system is planned to improve data accuracy, reliability, redundancy, and instrument radiation tolerance. Past experience is being applied in adding or relocating devices to simplify tuning procedures. (auth)

1613 (LBL-3370) DIGITAL CONTROLLED FREQUENCY FOR SYNCHROTRON ACCELERATION. Clinnick, M.; Greer, J.; Guggemos, J.; Kilgore, R.; Rondeau, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1975. Contract W-7405-eng-48. 5p. (CONF-750335-50). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The ability of synchrotrons to accelerate particles with different e/m_0 values is dependent upon being able to control its accelerating-voltage frequency as a function of the actual guide field value. Interpolation between modification values can be performed to reduce the possibility of exciting phase oscillation. Differences between the desired frequency and the actual frequency produced (due to non-linearities in the system) are also removed with the digital processor increasing the precision of the system up to two orders of magnitude. Successful operation with six different particles has been demonstrated. (auth)

1614 (SAND-74-5602) UNTRIGGERED WATER SWITCHING. Van Devender, J. P.; Martin, T. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 19p. (CONF-750335-1). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Recent experiments indicate that synchronous untriggered multichannel switching in water will permit the development of relatively simple, ultra-low impedance, short pulse, relativistic electron beam (REB) accelerators. These experiments resulted in the delivery of a 1.5 MV, 0.75 MA, 15 ns pulse into a two-ohm line with a current risetime of 2×10^{14} A/sec. The apparatus consisted of a 3 MV Marx generator and a series of three 112 cm wide strip water lines separated by two edge-plane water-gap switches. The Marx generator charged the first line in less than 400 ns. The first switch then formed five or more channels. The second line was charged in 60 ns and broke down with 10 to 25 channels at a mean field of 1.6 MV/cm. The closure time of each spark channel along both switches was measured with a streak camera and showed low jitter. The resulting fast pulse line construction is simpler and should provide considerable costs savings from previous designs. Multiples of these low impedance lines in parallel can be employed to obtain power levels in the 10^{14} W range for REB fusion studies. (auth)

1615 DESIGN OF THE RF SYSTEM FOR THE TRIUMF CYCLOTRON. Prochazka, A. Vancouver, B. C.; British Columbia Univ. (1972). 247p.

Thesis.

The basic design of the resonator system, coupling loop assembly and the resonant transmission line for the TRIUMF isochronous cyclotron is studied in detail and the beam-resonator rf field interaction is estimated using a simple model. The matching techniques which will allow a maximum power transfer from the power tube stage to the Dees are discussed. Two major computer programs have been written and are used to determine the parameters of the rf system necessary in order to obtain a desired impedance match and to find the various resonant frequencies of the rf system. The results of a large number of experimental tests carried out in order to verify the resonator electrical characteristics, to investigate the resonator frequency tuning and the resonator mechanical construction around the center post, and to apply the proposed matching technique to the TRIUMF rf system, are given. The results from the prototype resonator segments and the transmission line tested at high power both in air and under high vacuum indicate that the rf system performance is compatible with the cyclotron operation. (auth)

1616 MULTIPERIODICAL ACCELERATING STRUCTURES FOR LINEAR PARTICLE ACCELERATORS. Duc Tien Tran. (to Thomson-CSF). French Patent 2,192,435/A/. 7 Jul 1972. 17p. (In French).

These structures comprise a series of cylindrical cavity resonators which can be coupled by means of annular cavities located at the periphery thereof and coaxial therewith, these annular cavities being coupled by means of orifices with their associated cylindrical cavities. The sizes of these various cavities are selected so that the energy stored in the accelerating cavities be as high as possible, and the energy stored in the coupling cavities be substantially null. These structures are preferably used in electron or proton accelerators. (FR)

1617 HIGH-VOLTAGE PULSE GENERATORS. Malffre, B. (to CEA). French Patent 2,206,037/D/. 6 Nov 1972. 8p. (In French).

The invention relates to the pulse generators derived from the MARX circuit. Each of the generator cells comprises a pulse transformer, the secondary of which is connected between the transistor base and emitter and to the terminals of an adaptable impedance. The invention can be applied to the pulse generators for the pulsed control of photomultipliers and for electron injectors for a linear accelerator. (FR)

1618 HIGH SPEED LINAC-BEAM ANALYZER. Johnson, K. W. (to United States Energy Research and Development Administration). US Patent 3,873,839. 25 Mar 1975. Filed date 10 Apr 1974. 8p.

A device for analyzing a charged particle beam developed by an accelerator device having an rf driving signal is described. The particle beam passes through a transparent medium, developing light of intensity proportional to the intensity of the particle beam. A photocathode is aligned to detect the light and thereby generate an electron beam of intensity proportional to the intensity of the light. The rf driving signal is coupled via a phasevarying network to an X-axis deflection system and, after a phase shift of 90^0, to a Y-axis deflection system. The electron beam is directed through the X-axis and Y-axis deflection system, thereby causing the electron beam to precess about an axis and describe a circular trace

in a plane perpendicular to the axis. Means are provided to measure the intensity of the beam along a particular narrow are of the circular trace as the phase of the rf signal applied to the X and Y deflection system is varied from 0^0 to 360^0. (Official Gazette)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 332.

1619 (BNL-19831) MEASUREMENT OF THE LINEAR COUPLING IN THE BROOKHAVEN AGS. Raka, E. C. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 4p. (CONF-750335-56) Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The magnitude and sign of the zeroth harmonic skew quadrupole component of the magnetic field at 28.5 BeV are determined by exciting and normal mode frequencies in part of the debunched beam present during a flat top extraction cycle. Simple rf excitation of the (9-Q) mode is employed. Filtered difference signals from pick-up electrodes are used to measure the frequencies and relative phases of the H and V oscillations. During acceleration when the beam is bunched it is kicked horizontally and the radial position adjusted until the coupled vertical motion in the (9-Q) mode reaches a maximum. Correction quadrupoles are then powered to minimize the observed amplitude. The magnitude of the coupling roughly tracks with the beam momentum. Saturation effects at high fields plus the powering of backleg bumps and tuning quadrupoles on the SEB flat top are possible sources of the somewhat larger coupling observed under these conditions. (auth)

1620 (HMI-B-158) PRE-ACCELERATOR FOR A HEAVY ION CYCLOTRON. Study on the Suitability of Various Types as Injector for the VICKSI Cyclotron. Jahnke, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). May 1974. 48p. (In German). Dep. NTIS (US Sales Only) $5.50.

A separated magnet-four sector cyclotron for the acceleration of heavy ions will be installed at HMI. The ions are preaccelerated in a 6 MV Van de Graaff and after stripping injected into the cyclotron. Other possible preaccelerators are studied. The characteristics of such an accelerator combination are reviewed. For the considered preaccelerators, the anticipated total system performance (beam current versus ion and energy) is given. (auth)

1621 (JINR-P8-8563) CRYOMAGNETIC SYSTEM OF THE ELECTRON BEAM MULTICHARGED ION SOURCE. Aksenov, V. G.; Donetz, E. D.; Zel'dovich, A. G.; Pikin, A. I.; Shishov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The construction and test results of the cryomagnetic system of the electron beam multicharged ion source equipped with a superconducting solenoid are described. The length of the solenoid is 1200 mm; coil diameter (average) is 54 mm; maximum induction is 1.35 Tl. The superconducting magnetic system (SMS) was activated in the persistent current operation mode. A continuous persistent current operation of the SMS was realized for 2 months without a substantial fall of persistent current (<10%). An essential property of the SMS consists in that its elements are placed under vacuum, and their cooling is performed by means of clapping connections with a cryostat. It is shown experimentally that such a method of thermostating the SMS is very convenient for designing systems with hard requirements for vacuum conditions, experimental setups and in some other cases. (auth)

1622 (LA-UR-75-401) PROTOTYPE HIGH CURRENT, HIGH DUTY FACTOR NEGATIVE HYDROGEN ION SOURCE FOR LAMPF. Lawrence, G. P.; Hayward, T. D.; Jackson, J. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 4p. (CONF-750335-29). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Present plans for the high current proton storage ring at LAMPF incorporate charge changing (stripping) injection of H^- ions in all modes of operation. Achievable stored current levels in this device will be strongly dependent on the maximum H^- beam intensity which can be accelerated by the linac, consistent with acceptable beam spill. This requirement has stimulated a program to develop an H^- ion source capable of providing a suitably high peak current (up to 25 mA) at high duty factor (up to 12 percent), with a normalized x,x' or y,y' emittance acceptable to the accelerating system. There are presently two main approaches which could lead to H^- ion sources providing this kind of performance. These are (a) the charge exchange method, in which an intense proton beam is fractionally converted to H^- beam in a suitable charge adding medium, and (b) the direct extraction method, in which H^- ions are obtained by a surface emission process associated with a gas discharge plasma. While both approaches may eventually find optimum application in different situations, it is not obvious, at present, which scheme will turn out to be the most satisfactory for LAMPF. A prototype charge exchange H^- ion source has been constructed as a first step in the development program and is presently being evaluated. Work on surface emission direct extraction techniques is in the planning stages. (WHK)

Ion Optics and Field Calculations

Refer also to abstract 987.

1623 (BNL-19769) RESONANCE EXCITATION BY DISTORTION OF THE BETA-FUNCTION COUPLED WITH A SINGLE BEAM SPACE CHARGE FORCE. Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-54). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

It is shown how a single beam space charge force can combine with a lattice design having large beta variations, such as occurs in machines with low beta insertions, to induce resonance behavior. Although the single beam space charge force may be highly nonlinear, it will, by itself, excite no resonances, since its azimuthal Fourier decomposition is essentially composed of 0th harmonic. However, low periodicity, large beta variations are harmonically rich and can provide the necessary azimuthal harmonics for resonance excitation. The resonance characteristics of this type of system are developed. A strength parameter involving the linear tune shift and the beta/sub max/ value is introduced. In particular, two cases are discussed: (1) where the force arises from the beam self-field and (2) where the force is induced by images in the surrounding boundaries. A comparison is made with the beam-beam force in terms of both the strength parameters (related to the linear tune shifts), and the nonlinear resonance behavior. (auth)

1624 (BNL-19785) INCOHERENT TRANSVERSE SPACE CHARGE EFFECTS DURING INJECTION, RF CAPTURE AND EARLY ACCELERATION IN AGS. Claus, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-49). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

After a review of the present situation in the AGS incoherent space charge effects in respectively the just injected beam, the coasting beam and the bunched beam are considered. Numerical estimates of shifts and spreads in betatron frequencies are given. The ratio of peak to average azimuthal densities in bunched beams is calculated for parabolic and uniform initial energy distributions. It is concluded that the intensity limit of the AGS is probably set by loss of particles out of vertical betatron phase via resonances and coupling in the early bunched beam. (auth)

1625 (JINR-P9-8379) RELATION BETWEEN PARTICLE DENSITY IN ELECTRON-ION BEAMS AND LONGITUDINAL MAGNETIC FIELD. Bonch-Osmolovskii, A. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A possible influence of kink-instability (Budker-Buneman instability) on the particle density in linear two-component beams is discussed. The analytical relation between beam parameters, in particular charge density, and magnetic field which stabilizes instability, was obtained, i.e., $H = (fZ\lambda/c\beta_e^2)\, j_e$, where f is the degree of charge neutralization, eZ is the ion charge, λ is the perturbation wave length, c is the speed of light, $\beta_e = v_e/c$, v_e is the speed of electrons, j_e is the electron current density. (auth)

1626 (JINR-P9-8477) NUMERICAL STUDY OF ELECTROMAGNETIC WAVE SCATTERING BY A RING BUNCH OF PARTICLES. II. Solution of the System of Equations for Amplitudes. Shvachka, A. B.; Urazakov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1975. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

Coefficients for the scattering of electromagnetic waves by a ring bunch of particles are calculated. A numerical solution of

the system of linear differential equations for amplitudes is described. A discussion of the results is presented. (auth)

1627 (LBL-3367) BEVALAC BEAM TRANSPORT SYSTEM. Avery, R.; Behrsing, G.; Morgado, R.; Rondeau, D.; Salsig, W.; Selph, F.; Staples, J.; Yourd, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 5p. (CONF-750335-19). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The Bevalac consists of, in part, a 200 meter long transfer line between the SuperHILAC and the Bevatron, which are at differing elevation. Unique features in the construction of the transfer line are described. The line, located largely outside, must cope with a natural environment. Part of the line passes through a hillside, requiring some unique support and alignment techniques. The dipoles are of the tape-wound variety and the steering magnets use printed circuit conductors. The vacuum system and an inexpensive and effective destructive monitoring system are described. (auth)

1628 NUMBER OF EFFECTS OF SPACE CHARGE IN SUPERCONDUCTING ACCELERATORS AND STORAGE RINGS. Vol. I. Meshcherov, R. A.; Rybalko, V. S. (Radio Technical Inst., Moscow). pp 123-125 of Trudy Tret'ego Vsesoyuznogo Soveshchaniya Po Uskoritelyam Zaryazhennykh Chastits. Tom I. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

This study considers the nonresonance effects of space charge for superconducting accelerators and storage rings in cases where a vacuum chamber of circular cross section and a cylindrical iron screen are used. It is shown that the most substantial effect is the dependence of the noncoherent shift of frequencies on the amplitude of the coherent beam oscillations and the displacement of the closed orbit. Results of computer calculations are presented of the dependence of the frequencies of the noncoherent oscillations on the number of particles and on the radius of the chamber at various values of the radial displacement of the beam. (tr-SJR).

1629 ESTIMATE OF THE ANGULAR DIVERGENCE IN INTENSE ELECTRON BEAMS. Kuznetsov, V. S.; Vakhrushin, Yu. P.; Komarov, O. L.; Fidel'skaya, R. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 7, 868-870(Jan 1975).

Translated from Zh. Tekh. Fiz.; 44: No. 7, 1385-1388(Jul 1974).

The focusing of intense electron beams in a longitudinal magnetic field is discussed. Analytical expressions are derived for the maximum angular divergence arising from nonlinear Coulomb forces. A comparative analysis is given of the angular divergence as a function of the method used to shape the electron beam. (auth)

Storage Rings

1630 (BNL-19793) FULL-SCALE ISA DIPOLES. McInturff, A. D.; Dahl, P. F.; Damm, R.; Lasky, C.; Robins, K.; Sampson, W. B. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-34). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

After the life test of the two 8-cm (diameter) aperture one-meter long magnets (ISA I and II) had been satisfactorily concluded, the next logical step is the construction of a full-scale (12-cm aperture 4.25-meter long) dipole. The 12-cm magnet is essentially a larger version of ISA I and II with the exceptions of conductor and structural material refinements that have evolved in the 5 and 8-cm ape aperture model magnet series and comparable programs in other laboratories. The magnet windings will have a 23 percent higher packing density than ISA I and II. The rate of magnetic field sweep at which the magnetization of the magnet doubles, is an order of magnitude faster, due to improved conductor geometry. The peak magnetic field is approximately 5 percent greater than the central field 'B(0,0)' in the new design which has 85 percent usable aperture (approximately 67 percent actually required). The design field 'B(0,0)' is 4.0 T at 4.5°K. The coil parameters are ID equals 12.05 cm, OD equals 15.538 cm, length equals 427 cm and 80 turns/pole. The magnet is presently under construction and only prototype data and computed characteristics are presently available. (auth)

1631 (BNL-19821) STORAGE ACCELERATOR BENDING MAGNET WITHOUT MEDIAN PLANE SYMMETRY. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-750335-37). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

An H-magnet with no median plane symmetry, in which all the current carrying coils lie below the median plane, has been studied using the GRACY magnet program. This magnet was suggested by A. vanSteenbergen and has several possible advantages for use in a superconducting storage accelerator. The field multipoles violating median plane symmetry were found to be small, and correctable with small correction coils. In addition, it was found possible to reduce these undesired multipoles considerably by shaping the iron pole face. (auth)

1632 (BNL-19822) COMPARISON OF COLD AND WARM VACUUM SYSTEMS FOR INTERSECTING STORAGE RINGS. Halama, H. J.; Herrera, J. C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-52). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

In storage rings employing superconducting magnets, the use of a cold bore as a cryopump appears, at first glance, as simple and economical. Since the selection of a cold or warm vacuum system has far-reaching implications on the basic design, each system is considered in some detail. The theoretical and practical limitations imposed on the maximum beam current by the gas desorption from the chamber walls are discussed. A realistic design of a cold vacuum chamber is developed and then compared with the proposed warm ISABELLE vacuum system. The comparison shows that the warm approach is preferable. (auth)

1633 (BNL-19832) EFFECTS IN LOW PERIODICITY LATTICES RESULTING FROM LOW BETA INSERTIONS. Chasman, R. W.; Courant, E. D.; Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-47). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Some of the limitations to the introduction of matched insertions into a cell-lattice structure are considered by studying a set of simple insertions characterized essentially by the effective strength of a focusing triplet. Results indicate that the maximum allowable strength may be much less than has previously been assumed. However, in at least one of the examples, a momentum aperture on the order of 2 percent as required for ISABELLE seems attainable. Also, the impact of structure resonances on the choice of central tune is considered. As well as exciting a $\frac{1}{3}$ integer structure resonance, the necessary sextupoles for chromaticity correction also excite a $\frac{1}{4}$ integer resonance. Using insertion IV, some of the characteristics of this resonance are shown; in particular, an unstable phase space topology even for very small vertical amplitudes. (auth)

1634 (BNL-19934) QUASI-COMBINED FUNCTION MAGNETS FOR ISABELLE. Sampson, W. B. (Brookhaven National Lab., Upton, N. Y. (USA)). 3 Mar 1975. 5p. Dep. NTIS $4.00.

A magnet design in which the dipole and quadrupole windings are located concentrically in the same iron core is proposed. The resultant space saving in the lattice leads to a higher energy for ISABELLE without changing the overall ring size. Other advantages of this design are discussed briefly. (auth)

1635 (LNF-75/6(R)) POSSIBILITY OF ACHIEVING VERY HIGH ENERGY RESOLUTION IN ELECTRON-POSITRON STORAGE RINGS. Renieri, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 3 Feb 1975. 16p. Dep. NTIS (US Sales Only) $4.00.

The energy dispersion of the existing electron-positron storage rings is very large with respect to the energy width of the recently discovered narrow 3.1 and 3.7 GeV resonances. In Adone, for example, the full width half maximum center of mass energy dispersion is about 3 MeV (at 1.5 GeV), while the 3.1 GeV resonance width is of the order of 100 keV. A method to achieve a high center of mass energy resolution which utilizes the correlation existing between the transverse position and the displacement ΔE from the synchronous energy of a particle travelling inside a storage ring, as given by the off-energy function ψ is discussed. (WHK)

Experimental Facilities

Refer also to abstract 983.

1636 (AED-CONF-74-509-030) THE ENERGY DISTRIBUTION OF D-T NEUTRONS IN LUCITE AT THE NEUTRON THERAPY EQUIPMENT IN-HAMBURG-EPPENDORF. Magiera, E.; Schmidt, R.; Sittig, R.; Bormann, M. (Hamburg Univ. (F.R. Germany). Radiologische Klinik und Strahleninstitut). 1974. 4p. (In German). INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen (30 Sep 1974).

7 figs.; 1 tab.; 4 refs. With abstract.

The energy distribution was measured in 8 different depths with the activation method using threshold detectors. Six foils consisting of different detector materials were used with thresholds between 4 and 12 MeV. The induced radioactivities were detected with a 3′ × 3′ NaI-well counter. The initial activities of the foils were normalized by using a reference foil. With the help of well-known excitation functions, the energy distributions have been computed. These spectra are compared with neutron spectra measured with a recoil-proton telescope. A special effort was made to measure also the flux of slow neutrons present in the spectra. (auth)

1637 (AED-CONF-74-509-032) DOSIMETRIC PROPERTIES OF THE FAST NEUTRON THERAPY BEAMS AT TAMVEC. Almond, P. R.; Smith, A. R.; Smathers, J. R.; Otte, V. A. (Texas Univ., Houston (USA). Dept. of Physics). 1974. 8p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

A clinical trial of fast neutron radiotherapy using the cyclotron at Texas A and M University has been initiated in 1972. Initially, the study used neutrons produced by bombarding beryllium with 15 MeV deuterons, but since March, 1973, neutrons from 50 MeV deuterons have been used. The dosimetric properties of the MeV beam have also been measured for comparison with the neutron beams from D-T generators. The three beams are compared in terms of dose rate, skin sparing, depth dose and field flatness. Isodose curves for treatment planning were generated using the decrement line method and compared to curves measured by a computer controlled isodose plotter. This system was also used to measure the isodose curves for wedge fields. Dosimetry checks on various patients were made using silicon diodes as in vivo fast neutron dosimeters. (auth)

1638 (AED-CONF-74-509-033) DOSIMETRY INTERCOMPARISONS BETWEEN FAST NEUTRON RADIOTHERAPY FACILITIES. Almond, P. R.; Smith, A. R.; Smathers, J. B.; Otte, V. A. (Texas Univ., Houston (USA). Dept. of Physics). 1974. 14p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract. Available from ZAED.

Neutron dosimetry intercomparisons have been made between M. D. Anderson Hospital and Tumor Institute, Naval Research Laboratory, University of Washington Hospital, and Hammersmith Hospital. The parameters that are measured during these visits are: tissue kerma in air, tissue dose at depth of dose maximum, depth dose beam profiles, neutron/gamma ratios and photon calibrations of ionization chambers. A preliminary report of these intercomparisons is given including a comparison of the calculation and statement of tumor doses for each institution. (auth)

1639 (BNL-19801) PRELIMINARY DESIGN OF A 30 MeV DEUTERON LINEAR ACCELERATOR FOR THE PRODUCTION OF INTENSE BEAMS OF 14 MeV NEUTRONS. Batchelor, K.; Chasman, R.; Fewell, N.; Grand, P.; Lankshear, R.; Sheehan, J.; Witkover, R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-750335-45). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The study of radiation damage to materials used to build containers for a fusion reactor requires a beam of neutrons with energy peaked at approximately 14 MeV and with a total flux of greater than or equal to 10^{14} neutrons/cm^2 sec in order to carry out tests in a reasonable time scale. This report describes a Deuteron Linear Accelerator, utilizing an Alvarez structure, which is designed to produce neutron energy and flux of the above values by allowing a 30 MeV deuteron beam of 100 mA continuous current to strike a liquid lithium target. (auth)

1640 (BNL-19823) SUPERCONDUCTING MAGNET SYSTEM FOR THE AGS HIGH ENERGY UNSEPARATED BEAM. Morgan, G.; Aggus, J.; Bamberger, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-750335-33). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

A beam line to the Multi-Particle Spectrometer capable of handling 30 GeV/c secondary beams will consist of four large identical superconducting dipoles and a number of room temperature quadrupoles. The total bending angle is 20^0, 5^0 per magnet, and the room temperature aperture required in the dipoles is 20 cm. The four dipoles will be of the cos theta type and will have an overall length of 2.5 m and nominal maximum field of 4.0 T at 2800 A. The conductor will be a thin, wide metal-impregnated braid. The circular aperture is surrounded by coils which are a six-block approximation to a single-layer cos theta current sheet, and a coaxial cylinder of laminated iron at helium temperature. Each magnet will weigh about 10 tons. The design of the dewar including its heat load is discussed. The system is planned to be operational in Fall 1975. (auth)

1641 (CONF-750335-32) INITIAL TEST OF A PROTON RADIOGRAPHIC SYSTEM. Moffett, D. R.; Colton, E. P.; Concaildi, G. A. (Argonne National Lab., Ill. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Protons have a well defined range in matter. A detector, therefore, placed near the end of range of a monoenergetic proton beam becomes a very sensitive measure of changes in the mass of material which the beam has traversed. This property of protons can be exploited in a variety of ways to make radiographs of solid objects. The experimental radiography system we have built to use with the 200 MeV booster synchrotron of the Zero Gradient Synchrotron (ZGS) is described. In addition, there is a brief description of a more elegant system which would operate with a suitable source such as the proton diagnostic accelerator proposed by R. Martin. (auth)

1642 (INIS-mf-1660) PROGRESS AND STATUS REPORT FOR THE UNIVERSITY OF TORONTO POLARIZED HELIUM-3 TARGET AND ASSOCIATED PROJECTS. (Toronto Univ., Ontario (Canada). Dept. of Physics). Dec 1972. 41p. INIS.

The apparatus for producing a polarized ^{3}He target is described. It consists of a low pressure (1 Torr) chamber in which ^{3}He atoms are excited by an electrical discharge and then polarized by ^{4}He circularly polarized light. The polarized ^{3}He is compressed to one atmosphere by a Toepler pump. Gas recirculation is used to overcome relaxation in the one atmosphere target chamber. Problems with short relaxation times are discussed. The degree of polarization is determined by NMR. Then a (p,pn) reaction at 680 MeV on unpolarized ^{3}He targets is described to study the momentum distribution of the unpaired neutron in ^{3}He. Gaseous ^{3}He was used and then liquid ^{3}He, ^{2}H, and ^{4}He. The method of data analysis is described. Finally, a chemical transport furnace with four independently controlled temperature zones is described for the vapor phase method of growth of In $P_{1-x}As_x$ semiconductors for lasers. (INIS)

1643 (INIS-mf-1696) GAS TARGET NEUTRON GENERATOR. Atomic Energy of Canada Limited. Contract Report April 1, 1973 to March 31, 1974. deLeeuw, J. H.; Haasz, A. A.; Stangeby, P. C.; Robinson, J. E. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). 30 Apr 1974. 22p. INIS.

18 p. appendix on plasma production theory.

Experimental studies of the Lidsky-Colombant gas target neutron generator concept were performed with the use of a keV energy electron beam interacting with helium, argon and nitrogen free jets. Beam energies were chosen such that the beam stopping distance was approximately equal to two orifice diameters. Measurements of electron beam stopping distances in helium were found to be in good agreement with calculated values obtained from a Monte-Carlo transport code. Measurements of the maximum beam power coupled to this gas yielded typical heating ratios, Q, of 0.25, 0.50, and 0.65 for helium, argon, and nitrogen gases, respectively. This coupled power was found to be primarily in the form of heat deposited in the gas. In addition, the gas flow appeared to be relatively stable in these Q values. For the experiments undertaken, the ratios of the coupled power to the total beam power were less than approximately 25%. This low coupling efficiency is due primarily to electron beam scattering downstream of the orifice. A theoretical investigation of the plasma formation was also undertaken. The general conclusion reached was that the plasma properties cannot be predicted for the experiment with a high degree of certainty from a theoretical basis. It will be necessary to experimentally determine these parameters. (auth)

1644 (INIS-mf-1697) PROGRESS AND STATUS REPORT FOR THE UNIVERSITY OF TORONTO POLARIZED HELIUM-3 TARGET. (Toronto Univ., Ontario (Canada). Dept. of Physics). Dec 1971. 27p. INIS.

The construction of a polarized ^{3}He target is described. The ^{3}He is polarized by laser optical pumping. A parametric oscillator, Nd^{3+} in $YAlO_3$ and an In($As_{1-x}P_x$) laser are described. Initial preparations for the ^{3}He(p; n)^{3}T reaction at 680 MeV are described. (INIS)

1645 (LA-UR-75-425) RADIOACTIVITY, SHIELDING, RADIATION DAMAGE, AND REMOTE HANDLING. Wilson, M. T. (Los Alamos Scientific Lab., N. Mex. (USA)). 12 Mar 1975. Con-

tract W-7405-ENG-36. 8p. (CONF-750335-44). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Proton beams of a few hundred million electron volts of energy are capable of inducing hundreds of curies of activity per microampere of beam intensity into the materials they intercept. This adds a new dimension to the parameters that must be considered when designing and operating a high-intensity accelerator facility. Large investments must be made in shielding. The shielding itself may become activated and require special considerations as to its composition, location, and method of handling. Equipment must be designed to withstand large radiation dosages. Items such as vacuum seals, water tubing, and electrical insulation must be fabricated from radiation-resistant materials. Methods of maintaining and replacing equipment are required that limit the radiation dosages to workers. The high-intensity facilities of LAMPF, SIN, and TRIUMF and the high-energy facility of FERMILAB have each evolved a philosophy of radiation handling that matches their particular machine and physical plant layouts. Special tooling, commercial manipulator systems, remote viewing, and other techniques of the hot cell and fission reactor realms are finding application within accelerator facilities. (auth)

1646 (LA-UR-75-427) RELIABILITY ENGINEERING FOR FACILITY EFFECTIVENESS. Jameson, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 7p. (CONF-750335-28). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The problem of optimizing the effectiveness of a large scientific facility is considered in a discussion of the probabilistic, statistical, engineering, and managerial aspects of reliability. (auth)

1647 (LA-UR-75-439) PARTICLE SEPARATION AT LOS ALAMOS. Liska, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 5p. (CONF-750335-30). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The beam separator under development at LAMPF for the EPICS channel (Energetic Pion Channel and Spectrometer) is described. The separator operates on the electrostatic crossed-field principle but has several unusual features. (WHK)

1648 (LA-UR-75-447) TUNING OF THE FIRST SECTION OF THE BIOMEDICAL CHANNEL AT LAMPF. Paciotti, M. A.; Bradbury, J. N.; Helland, J. A.; Hutson, R. L.; Knapp, E. A.; Rivera, O. M.; Knowles, H. B.; Pfeufer, G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 6p. (CONF-750335-36). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Results are presented from the tuning of the first section of the Biomedical Channel at LAMPF; the work centers about the use of the third bending magnet as a magnetic spectrometer. The momentum resolution at the intermediate focus is given in detail. The performance of a wedge degrader that compresses the wide momentum acceptance of the first section is discussed. The output pi$^-$ rate is also given. (auth)

1649 (SGAE-2377) BEAM DEFLECTION VOLTAGE AND REFERENCE VOLTAGE FOR AN ION-PROBE. Schoeberl, E.; Prager, L. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Jul 1974. 13p. (In German). EL-38/74). Dep. NTIS (US Sales Only) $4.00.

Two digital controlled voltage sources are described. The beam deflection voltage (0 to 2 kV beam deflection) enables an x-y deflection for an ion-beam. The reference voltage (output voltage 0 to +10V, current 0.5A stability 10^{-4}) is used as a control voltage for multiplying digital-to analog-converters. (auth)

1650 NEUTRON GENERATION AND NEUTRON SOURCES. Hannappel, L.; Schneider, H. (Giessen Univ. (F. R. Germany). Abt. Grossgeraete). Kerntechnik; 17: No. 1, 36-41(Jan 1975). (In German and English).

Fast neutrons from natural (radioactive) neutron sources, from special targets of particle accelerators and from nuclear reactors are used increasingly in research, industry and medicine as a form of high energy radiation. This first of four contributions on this general subject discusses summarily the physics of neutron production by nuclear reactions and describes briefly the neutron sources used at present, their energy spectra and their yields. The possibilities of using almost all types of particle accelerators as intensive neutron sources are briefly sketched. Nuclear reactors are not considered. (auth)

1651 REAL TIME DATA ACQUISITION SYSTEM FOR THE HIGH CURRENT TEST FACILITY PROTON ACCELERATOR. Langlais, C. E.; Erickson, P. D.; Caissie, L. P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 480-483(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A real time data acquisition system was developed to monitor and control the High Current Test Facility Proton Accelerator. It is a PDP-8/E computer system with virtual memory capability that is fully interrupt driven and operates under a real-time, multi-tasking executive. The application package includes mode selection to automatically modify programs and optimize operation under varying conditions. (auth)

1652 BISON-NET, A HIGH SPEED BLOCK MULTIPLEXER CHANNEL FOR INTERCONNECTING COMPUTERS VIA CAMAC. Brenner, A. E.; Droege, T. F.; Martin, R. G. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 494-498(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

A high speed network communications station has been developed to serve to interconnect a variety of computers in a multiplexed star network at the Fermi National Accelerator Laboratory. Each station consists of one control module and two memory modules embodied as CAMAC modules. Transmission is over coaxial lines with typical distances between stations of from 1 to 2 miles. The transmission rate is 4 MHz. (auth)

1653 CAMAC EXTENDED BRANCH SERIAL DRIVER. Brenner, A. E.; Martin, R. G. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 511-516(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Extended Branch Serial Driver (EBSD) has been developed to provide a serial extension of the present CAMAC Multi-Crate Branch Highway System. This serial driver provides an interface to the NIM proposed CAMAC Multi-Crate Serial Highway System using an existing Branch Highway and Driver configuration. The EBSD can be operated in either a bit serial or a byte serial node. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Refer also to abstracts 1733 and 1828.

1654 (N-74-28299) HIGH-ENERGY GAMMA-RAY ASTRONOMY. Fichtel, C. E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1974. 38p. (NASA-TM-X-70681; X-662-74-183). NTIS $5.00.

The SAS-2 gamma ray experiment and its detection of celestial gamma rays are described. Data also cover intensity of high energy gamma rays, gamma ray distribution, gamma ray origin, and diffuse radiation. (STAR)

Cosmic Radiation

Refer also to abstracts 816, 819, 856, 860, 861, and 1867.

1655 (N-74-26267) ORIGIN OF THE DIFFUSE BACKGROUND GAMMA RADIATION. Stecker, F. W.; Puget, J. L. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1974. 30p. (NASA-TM-X-70665; X-602-74-157). NTIS $4.50.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

Recent observations have now provided evidence for diffuse background gamma radiation extending to energies beyond 100 MeV. There is some evidence of isotropy and implied cosmological origin. Significant features in the spectrum of this background radiation were observed which provide evidence for its origin in nuclear processes in the early stages of the big-band cosmology and tie in these processes with galaxy formation theory. A crucial test of the theory may lie in future observations of the background radiation in the 100 MeV to 100 GeV energy range which may be made with large orbiting spark-chamber satellite detectors. A discussion of the theoretical interpretations of present data, their connection with baryon symmetric cosmology and galaxy formation theory, and the need for future observations are given. (STAR)

1656 (N-74-26268) TWO VIEWS OF COSMIC-RAY PROPAGATION IN THE SOLAR SYSTEM. Barouch, E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1974. 15p. (NASA-TM-X-70664; X-693-74-155). NTIS $4.00.

Diffusion and scatter free cosmic ray propagation theories are discussed in terms of the quality of their alternate viewpoints. A hypothetical model of conditions in interplanetary space is described which aids in the comparison. A plot of the intensity of the interplanetary magnetic field over a long period is presented, and the association of these regions with high velocity streams is shown to support the scatter free viewpoint. (STAR)

1657 THE PRODUCTION OF ^{21}Na BY LOW-ENERGY PROTONS IN METEORITES. Herzog, G.F. (Department of Chemistry, Douglass College, Rutgers University, New Brunswick, New Jersey 08903). J. Geophys. Res. 80: No. 8, 1109-1112 (10 Mar 1975).

The cross sections for ^{21}Na production induced by 10−, 12−, 14−, and 16-MeV protons on natural Mg targets have been measured as 0.21 ± 0.08, 17.0 ± 2.5, 45.2 ± 6.8, and 44.0 ± 6.6 mb, respectively. These values imply that just below the surface the ^{22}Ne/^{21}Ne ratios found in extraterrestrial samples would be lowered by an excess of low-energy protons. Unfortunately, the lowering will in most cases be masked by other effects. (auth)

1658 CAUSES OF FORBUSH DECREASES AND OTHER COSMIC RAY VARIATIONS. Barouch, E.; Burlaga, L.F. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 4, 449-456 (1 Feb 1975).

The relationship between neutron monitor variations and the intensity variations of the interplanetary magnetic field is studied by using Deep River data and Imp series satellite data. In over 80% of the cases studied in 1968, identifiable depressions of the cosmic ray intensity are associated with magnetic field enhancements of several hours duration and intensity above 10 γ. Conversely, almost every magnetic field enhancement has an identifiable effect (though not necessarily a marked depression) on the cosmic ray intensity. Perpendicular gradient drifts are suggested as one possible mechanism producing the individual decreases, and some ideas on the recovery processes are presented. Long-lasting Forbush decreases are found to be the consequence of the action of several successive magnetic field enhancements. Evidence is presented that indicates that most of these enhancements are caused by the steepening of streams in interplanetary space. (auth)

1659 MODULATION OF LOW-ENERGY COSMIC RAYS. Sari, J.W. (Department of Physics, University of Maryland, College Park, Maryland 20742). J. Geophys. Res. 80: No. 4, 457-469 (1 Feb 1975).

Recent theories have related the diffusion of cosmic rays in the solar wind to the power spectrum of interplanetary magnetic field fluctuations. In this study the power spectrum-diffusion coefficient relation for low-energy protons ($T < 80$ MeV) is tested directly, and the relative contribution to the scattering from directional discontinuities in the magnetic field is examined. Modulation parameters V_w/K_{rr}, the solar wind speed divided by the radial diffusion coefficient, are calculated from Pioneer 6 magnetic field and solar wind data are compared with simultaneous Imp 3 observations of the 20− to 80-MeV proton flux. Daily variations in the 40− to 80-MeV proton flux are found to respond to changes in V_w/K_{rr}, as is predicted by a perturbation solution of the Fokker-Planck equation once the contribution from directional discontinuities in the magnetic field is subtracted from the diffusion coefficients. This finding is interpreted to imply that a large percentage of the identified discontinuities are basically tangential. A lack of correlation between the 20− to 40−MeV flux and the parameter changes is interpreted as being due to either the invalidity of the theory at lower energies or the presence of a continuous flux of high-energy solar protons. A well-defined time lag between changes in the 60− to 80−MeV proton flux and corresponding changes in V_w/K_{rr} is observed during a period when the interplanetary magnetic field is predominantly radial and the Imp 3-sun-Poineer 6 angle is greater than 10°. This lag is consistent with the interpretation of little or no cross-field diffusion or a perpendicular diffusion coefficient less than 3×10^{19} cm^2/s. (auth)

1660 SEMIDIURNAL COMPONENT OF COSMIC RAY INTENSITY. Kane, R.P. (Physical Research Laboratory, Ahmedabad, India). J. Geophys. Res. 80: No. 4, 470-481 (1 Feb 1975).

The amplitude r_2 and the hour of maximum ϕ_2 of the second harmonic of the neutron intensity at Deep River and Chacaltaya are studied for the period 1956–1968. It is shown that r_2 can be significant (exceeding 0.23%) at the both of these locations, not necessarily simultaneously. Also, the space direction of the second harmonic is neither field aligned nor perpendicular to the interplanetary magnetic field on many occasions. Neither of these facts agrees with the theoretical models presently in vogue. The possibility that r_2 is a parasite of r_1, owing to the possible limited sinusoidal nature of the space anisotropy, is examined, but the explanation is found to be only partly valid. On individual days, sharp decreases, particularly in the morning hours, are often observed, indicating sinks (rather than sources) as possible causes of the semidiurnal as well as the diurnal components. Highly diurnal patterns are sometimes observed at the equator as well as at high latitudes, indicating that the semidiurnal component is by no means a permanent feature in any region. As the daily values of r_2 can occasionally be as high as 0.5% and very frequently are 0.2% or more (all are statistically significant), average yearly values of the order of 0.05% or less used for theoretical explanations seem to be of dubious value. There are indications that the energy spectrum of the daily variation patterns may not remain constant throughout the day. (auth)

1661 COSMIC RAYS. Arens, M. (Amsterdam Univ. (Netherlands). Natuurkundig Lab.). SPARMO Bull.; 5: No. 4, 275-280(May 1974).

Some topics in cosmic ray research, which can still favorably be investigated with balloon-borne equipment, are presented: composition of galactic cosmic rays (in particular for particles with $Z \gtrsim 26$, and isotopic abundances); solar energetic particles (composition and spectrum); modulation (Forbush decreases including N-S anisotropies, cut-off variations and anomalous diurnal variations). (FR)

1662 SPECTRA AND ANGULAR DISTRIBUTION OF LOW ENERGY ATMOSPHERIC GAMMA RAYS AT LAMBDA EQUALS 40^0. Ling, J. C. H. San Diego, CA; Univ. of California (1974). 143p. University Microfilms Order No. 75-4646.

Thesis (Ph. D.)

Experimental and theoretical studies of low energy atmospheric gamma rays in the range 0.3 to 10 MeV at lambda equals 40^0 is the subject. A model was first constructed from which the angular and depth dependence of atmospheric gamma rays can be derived. The model consists of a depth and energy dependent isotropic source strength which depends on depth and energy expressed in the form S(E,x) equals $S_0(E)$ (1 + b(E)x + c(E)x²)e/sup -x/p(E)/ photons/(gm of air-sec-MeV) and is determined semi-empirically from the total flux measured previously with isotropic counters. Source strengths for 10 different energies in the continuum and 38 predicted atmospheric gamma-ray lines were determined. For the intensities between 0.3 and 10 MeV of the continuum, a diffuse

cosmic flux, consistent with the Apollo 15/16 is assumed in order to fit the measured data above 10 gm/cm^2. Total fluxes at 1 MeV computed for 3,5 and 70 gm/cm^2 are 1,1 and 2,6 photons/(cm^2-sec-MeV) respectively. Downward fluxes are 0,037 and 0,195 photons/(cm^2-sec-MeV-ster) and upward fluxes are 0,14 and 0,22 photons/(cm^2-sec-MeV-ster) respectively, for the same two depths. Growth curve predictions needed to separate atmospheric from diffuse cosmic fluxes were also determined. The computed flux, which compares well with other measurements and theoretical calculations, was verified experimentally. Angular distributions at 2,5 and 70 gm/cm^2 and depth variation of atmospheric gamma-ray fluxes were measured during the summer and fall of 1971 by a balloon-carried gamma-ray telescope with 113 cm^2 of sensitive area and a 50^0 FWHM field of view. The background spectra measured by the telescope at 2,5 gm/cm^2, which consisted of contributions from photon-leakage, neutron and spallation effects, was 93 percent of the total counting rate at 1 MeV. The amount contributed from the two dominant components, the photon-leakage and neutron, were determined from a Monte Carlo computation using model's predictions and measured neutron fluxes, respectively, as inputs to the code. (Diss. Abstr. Int., B)

Stars

Refer also to abstracts 1729, 1836, 1925, and 1982.

1663 (N-74-30288) ELECTRON AND ION DENSITIES IN INTERSTELLAR CLOUDS. Glassgold, A. E.; Langer, W. D. (New York Univ., N. Y. (USA)). 1974. 29p. (NASA-CR-138964). NTIS $4,25.

A quantitative theory of ionization in diffuse clouds is developed which includes H(+) charge exchange with O. Dissociative charge exchange of He(+) with H2 plays an important role in the densities of H(+) and He(+). The abundance of HD is also discussed. (STAR)

1664 (N-74-31323) PHOTOELECTRIC OBSERVATIONS OF KRZEMINSKI'S STAR, THE COMPANION OF CEN X-3. Petro, L. D. (Michigan Univ., Ann Arbor (USA)). 1974. 15p. (NASA-CR-139570). NTIS $4,00.

Centaurus X-3 was the first discovered x-ray source whose intensity is pulsed and eclipsed. Though the x-ray properties of the Cen X-3 system have been intensively studied, the optical properties remained unstudied until Krzeminski's identification of the optical counterpart of Cen X-3. Observations of the x-ray eclipse duration, pulsation, frequency variation, and pulse arrival time variation were used to place limits on the nature of the system and to predict the nature of the optical companion and x-ray sources. An observational determination is presented of the several system parameters based on a preliminary interpretation of the light curve of Krzeminski's star. (STAR)

1665 (N-74-32263) METER-WAVELENGTH OBSERVATIONS OF PULSARS USING VERY LONG BASELINE INTERFEROMETRY. Vandenberg, N. R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1974. 200p. (NASA-TM-X-70719; X-693-74-203). NTIS $13,00.

Thesis. Submitted to Maryland Univ., College Park.

The results of an investigation of the angular structure imposed on pulsar radiation due to scattering in the interstellar medium are presented. The technique of very-long-baseline interferometry was used to obtain the necessary high angular resolution. The interferometers formed by the Arecibo, NRAO, and Sugar Grove telescopes were used at radio frequencies of 196, 111, and 74 MHz during seven separate observing sessions between November 1971 and February 1973. A crude visibility function for the Crab nebular pulsar was obtained along with the correlated pulse profile. The technique of differential fringe phase was used to show that the pulsar and the compact source in the Crab nebula are coincident to within 0,001 arcsec which corresponds to approximately 2 a.u. at the distance to the nebula. The ratio of pulsing to total flux, and the fringe visibility of the time-averaged pulsing flux are also discussed, and apparent angular sizes of the pulsars were measured. (STAR)

1666 (UCRL-76301) NEUTRINO FLOW AND THE COLLAPSE OF STELLAR CORES. Wilson, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Dec 1974. 16p. (CONF-741215-1). Dep. NTIS $4,00.

From 7th Texas symposium on relativistic astrophysics; Dallas, Texas, USA (16 Dec 1974).

Calculations are repeated with a better model for the neutrino interactions in neutral current theories predicting a scattering cross section for heavy nuclei proportional to the square of the nuclear mass. These calculations showed that this high cross section may make it possible for the hot neutron star newly formed in stellar collapse to emit enough neutrinos to blow off the iron envelope which would surround the newly formed neutron star. (JFP)

1667 POSITIONS AND 1665 MHz LINE PROFILES FOR 10 NORTHERN OH EMISSION SOURCES. Caswell, J. L.; Robinson, B. J. (CSIRO, Epping, Australia). Aust. J. Phys.; 27: No. 4, 629-635(Aug 1974).

Positions with r.m.s. errors of about 20'' arc were determined for the stronger OH emission sources discovered in two northern searches. Line profiles at 1665 MHz with 1 kHz resolution are presented for both senses of circular polarization. (auth)

1668 18 cm OBSERVATIONS OF 19 NEW SOUTHERN OH EMISSION SOURCES. Robinson, B. J. (CSIRO, Epping, Australia); Caswell, J. L.; Goss, W. M. Aust. J. Phys.; 27: No. 4, 575-596(Aug 1974).

In a search for 1665 MHz OH emission in the southern Milky Way, 19 new sources were discovered. Line profiles of all four 18 cm transitions are presented for all but one of the sources, and the general properties of the sources and their distribution in relation to the position search were discussed. (auth)

1669 SYNTHESIS OBSERVATIONS OF SOUTHERN RADIO SOURCES AT 1410 MHz WITH THE PARKES INTERFEROMETER. II. Polarization and Brightness Distributions Across Seven Sources. Schwarz, U. J. (State Univ., Groningen, Netherlands); Whiteoak, J. B.; Cole, D. J. Aust. J. Phys.; 27: No. 4, 563-574(Aug 1974).

The Parkes two-element interferometer, which provides a maximum resolution of ~1' arc at a frequency of 1410 MHz, was used to obtain the distributions of polarization and brightness across seven extended sources. The results seem to be consistent with a previous interpretation in which the magnetic fields of evolved sources are orthogonal to the direction of elongation but those of relatively young sources are parallel to this direction. (auth)

1670 SUPERSONIC NEUTRAL WINDS IN AN OUTER ATMOSPHERE. I. Isothermal Conditions. Gilbert, N. E. (La Trobe Univ., Bundoora, Australia); Cole, K. D. Aust. J. Phys.; 27: No. 4, 511-528(Aug 1974).

The concept of steady nozzle flow along a narrow tube is applied to the motion of neutral gas constituents in a locally heated isothermal region of the outer atmosphere of a planet or star. The artificial nozzle throat at which the flow becomes supersonic is achieved by using one of two streamline functions within a vertical plane suggested by the possible shapes of convection cells. One streamline spirals above the surface of the planet at constant elevation, and the other "bends over" asymptotically towards the horizontal. The former achieves the nozzle throat by the gravitational force decreasing with distance from the center of the planet, while the latter relies on the gravitational component along the streamline decreasing as the streamline approaches the horizontal. Conditions under which the effects of viscosity and frictional interactions in the earth's atmosphere may be neglected from the assumed hydrodynamic description are considered. For the proposed models and boundary conditions appropriate to an intensely heated region of the Earth's atmosphere, the dependences of the critical distance, temperature boundary values, and velocity and heating profiles on variations in the parameters are shown. (auth)

1671 SUPERSONIC NEUTRAL WINDS IN AN OUTER ATMOSPHERE. II. Effects of Variable Temperature. Gilbert, N. E. (La Trobe Univ., Bundoora, Australia); Cole, K. D. Aust. J. Phys.; 27: No. 4, 529-540(Aug 1974).

Using the concept of steady nozzle flow along a narrow tube, the effect a variable temperature has on achieving one or two critical points is considered for a neutral gas in a locally heated region of the outer atmosphere of a planet or star. An implicit finite-difference formula, which does not require restrictions on the temperature variation for convergence, is used to solve the general nozzle flow equation. The direct dependence on temperature variation of a single critical point at which the flow becomes supersonic is shown for a model in which the gravitational force component is almost constant. The mathematical possibility of achieving a solution that passes through two critical points, such that in the intermediate region a reversal occurs and the velocity is supersonic, is demonstrated, and an example is given. (auth)

1672 PHOTOMETRIC OBSERVATIONS OF X PERSEI. Mook, D. E.; Boley, F. I.; Foltz, C. B.; Westpfahl, D. (Dartmouth Coll., Hanover, NH). Publ. Astron. Soc. Pac.; 86: No. 514, 894-898(Dec 1974).

Published photometric observations of the variable star X Per from 1888 to the present are presented along with new monitoring at approximately 10/sup s/ time resolution. No activity is observed at the 0,02 m level over time intervals of approximately

1/2 hour. The long-term history shows some changes in photometric properties since the discovery of the object's variability, but no regular pattern is evident. (auth)

1673 FINE ANALYSIS OF THE HELIUM-RICH STAR HD 184927. Higginbotham, N. A. Baton Rouge, LA; Louisiana State Univ. (1974). 196p. University Microfilms Order No. 75-1932.

Thesis (Ph. D.).

A fine analysis of the helium-rich star HD 184927 was performed by using a grid of flux-constant model atmospheres. The grid was computed utilizing a modified version of the program ATLAS. The models were computed on a grid bracketing the atmospheric parameters of HD 184927, as determined by an initial coarse analysis. The entire grid was computed under the assumption of local thermodynamic equilibrium. All relevant opacities, as contained in ATLAS, were employed. Models having T/sub eff/ less than 25,000°K and N(He) less than 0.9 were hydrogen-line (Lyman and Balmer) blanketed; models having T/sub eff/ greater than or equal to 25,000°K and/or N(He) greater than or equal to 0.9 were not. Helium profiles were computed with a code written by H. L. Shipman and provided by D. M. Peterson. The helium line-broadening theories are those of Barnard, Cooper, and Shamey (lambda 4471), Shamey (lambda 4388), and Gieske and Griem (lambda 4143). Balmer lines employed in this investigation were computed with the semi-empirical theory of Edmonds, Schluter, and Wells. All metallic abundances have been calculated from the final model. The metal abundances were found to be approximately normal for oxygen, carbon, nitrogen, magnesium, silicon, aluminum, phosphorus, and neon; sulfur, argon, and iron may be slightly overabundant. Mass, radius, luminosity, and distance were determined to be M equals 12.4 M/sub mass/, R equals 7.3 R/sub mass/, log (L/L/sub mass/) equals 4.1, and r equals 1.26 Kpc. These values of mass, radius, and luminosity are typical for helium-rich, or hydrogen-deficient, stars of which sigma Orionis E may be called a prototype. (Diss. Abstr. Int., B)

1674 COOLING OF SUPERFLUID NEUTRON STARS. Malone, R. C. Ithaca, NY; Cornell Univ. (1974). 330p. University Microfilms Order No. 74-17,650.

Thesis (Ph. D.).

The problem of the cooling rates of neutron stars is reexamined to take into account the effects of a superfluid energy gap on the heat content of the nucleons and on various neutrino loss rates. The rate of the modified Urca process (n + n yields n + p + e^- + anti nu/sub e/), which was the dominant neutrino energy loss mechanism in earlier calculations, is severely reduced by the presence of the superfluid gap in the energy spectrum of the neutrons and protons for central temperatures T/sub c/ less than or equal to 5 x 10^9 °K. Likewise, the heat capacity of the neutrons and protons is greatly decreased. Recent work on the state of neutron star matter by Baym, Bethe, and Pethick is also taken into account; their prediction of the existence of superheavy nuclei in neutron star matter at densities up to about 2 x 10^{14} g/cc provides an alternate source of heat capacity via the various modes of nuclear excitation at densities where the neutron contribution is greatly suppressed by superfluidity. The calculations include all neutrino loss mechanisms of importance and a careful treatment of the surface opacity and radiative luminosity. No magnetic field effects are considered. The computer calculations include a full treatment of radiative transfer, which is of particular interest during the very high temperature phase (T/sub c/ greater than 2 x 10^9 °K). The implications of the results for observation of thermal x rays from neutron stars and for other aspects of pulsar behavior are discussed. The calculations indicate that the cooling times are not altered significantly from those of earlier calculations; the reductions in the heat capacity and neutrino rates engendered by nucleon superfluidity tend to cancel each other. The resultant thermal x-ray flux is small compared to other energy fluxes associated with pulsars, making direct observation difficult but perhaps not impossible. Consideration is given to processes which might heat the neutron star, to uncertainties which might modify the conclusions reached here, and to effects not taken into account in the present calculations; in particular, arguments are given that, even if pions are present as a condensate in neutron star matter, they will not increase the cooling rate. (Diss. Abstr. Int., B)

1675 ABUNDANCE OF SODIUM IN THE RED GIANTS ALPHA TAURI AND BETA GEMINORUM. LoPresto, J. C. Ann Arbor, MI; Univ. of Michigan (1974). 85p. University Microfilms Order No. 74-25,257.

Thesis (Ph. D.).

An analysis of the atmospheres of Alpha Tauri and Beta Geminorum was carried out. Several high resolution spectroscopic coude plates as well as photoelectric energy distribution measurements were provided for the analysis. Microdensitometer tracings were obtained for twenty-one separate spectra on seven plates. After the tracings were calibrated, selected spectral regions were aligned according to wavelength and averaged with the aid of a computer program. The separate tracings and the averages were displayed on Calcomp plots. Using the average tracings, equivalent widths, half-widths, and line depths, were measured for lines of iron, sodium, magnesium, and calcium in the selected spectral regions. Model atmospheres, line profiles, and theoretical curves of growth were also calculated using computer programs. The comparison of the computed and observed curves of growth and line profiles allowed for the determination of the microturbulence and macroturbulence, as well as the abundances of iron, sodium, magnesium, and calcium. In Alpha Tauri, the microturbulence was estimated at 5 km/sec. In Beta Geminorum it was estimated at 3 km/sec. The macroturbulence in both stars was estimated with the help of the curve-of-line-width diagrams, as well as line profiles, to be roughly 4 or 5 km/sec. The abundances of iron, calcium and perhaps magnesium were found to be about equal to the corresponding abundances in the sun. The abundance of sodium in Alpha Tauri is in agreement with the solar value, whereas that for Beta Geminorum is over-abundant by a factor of almost five. (Diss. Abstr. Int., B)

1676 SPECTROPHOTOMETRY OF VV CEPHEI-TYPE SYSTEMS. Piccirillo, J. (Indiana Univ., Bloomington). Publ. Astron. Soc. Pac.; 86: No. 514, 890-893(Dec 1974).

Photoelectric spectrophotometry of four VV Cephei-type systems and two related objects is analyzed to derive the visual magnitude differences of the binary components. The results are in good agreement with previous photometric determinations. An extension of the present technique to other types of binary systems is briefly discussed. (auth)

1677 (O II) ELECTRON DENSITIES IN TWELVE PLANETARY NEBULAE. Lutz, J. H. (Washington State Univ., Pullman). Publ. Astron. Soc. Pac.; 86: No. 514, 888-889 (Dec 1974).

(O II) electron densities are presented for twelve planetaries, six of which have no published lambda 3726/3729 measurements. (auth)

1678 NARROW-BAND FILTER PHOTOGRAPHY OF IC 4406. Warner, J. W. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 86: No. 514, 885-887(Dec 1974).

The purpose of this note is to present photographs of the southern planetary nebula IC 4406 in the light of several emission lines and to discuss the apparent distribution of brightness of this object in order to suggest its geometry. With the subsequent addition of detailed spectral information such a suggestion can become the basis for a numerical model attempting to reproduce the observations. (auth)

1679 SUDDEN CHANGES IN THE PERIOD OF RT ANDROMEDAE. Williamon, R. M. (Univ. of Florida, Gainesville). Publ. Astron. Soc. Pac.; 86: No. 514, 924-931(Dec 1974).

Photoelectrically determined times of primary and secondary minimum are presented for the eclipsing binary RT And. These times of primary minima, when combined with other published minima, indicate that the system has undergone two sudden decreases in period since its discovery in 1901. The possibility of smaller amplitude, sporadic period jumps is also indicated. (auth)

1680 STUDY OF RADIAL VELOCITIES AND MAGNITUDES IN R CYGNI. Wojslaw, R. S. Publ. Astron. Soc. Pac.; 86: No. 514, 932-934(Dec 1974).

Ten coude spectra of R Cyg, obtained during four cycles in which the peak intensities differed by more than two magnitudes, were examined for a brightness–radial velocity relation. A more general relation was found in which the premaximum emission line radial velocities correlated strongly with magnitude, independent of both phase and the height of the maxima. (auth)

1681 INFRARED OBSERVATIONS OF LATE-TYPE DWARF STARS. Bopp, B. W.; Gehrz, R. D.; Hackwell, J. A. (Univ. of Wyoming, Laramie). Publ. Astron. Soc. Pac.; 86: No. 514, 989-992(Dec 1974).

Observations of twelve dM, dMe, and dKe stars from 2.3 mu to 11.4 mu are presented. The stars appear to radiate like cool blackbodies in the infrared. Color temperatures obtained from the infrared data yield photometric radii for seven stars. A correlation is found between spectral type as determined from low-dispersion spectrograms and a V – (2.3) color index. It is suggested that such a color index might be useful for classifying M dwarfs. The unusual variable UZ Lib has infrared color indices suggesting a normal giant, while spectrograms in the blue indicate a peculiar K dwarf. (auth)

1682 PHOTOELECTRIC STUDY OF THE ECLIPSING BINARY RT ANDROMEDAE. Dean, C. A. (Ohio State Univ., Columbus). Publ. Astron. Soc. Pac.; 86: No. 514, 912-923(Dec 1974).

New photometric elements were determined for the eclipsing system RT And. These elements are, k equals 0.741, r/sub a/ equals 0.239, r/sub b/ equals 0.322, and i equals 87.0^0. A new ephemeris is given. Asymmetries have been detected in both the primary and secondary eclipses. (auth)

1683 SPECTROSCOPIC STUDIES OF FLARE STARS: BD + $48^0$1958A. Bopp, B. W.; Fekel, F. Jr. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 86: No. 514, 978-980(Dec.1974).

BD + $48^0$1958A, a dM0e star that has exhibited H alpha variability on a time scale of hours, is shown to be a single-line spectroscopic binary of short period (1.03 d). A secondary component of H alpha, visible on only one plate, is attributed to the normally unseen, flaring secondary component. The system is predicted to show photometrically detectable flares, and V-band variations similar to those seen in BY Dra and CC Eri. (auth)

1684 HIGH-LUMINOSITY RED STARS IN OR NEAR GALACTIC CLUSTERS. Paper I. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 86: No. 514, 960-977 (Dec 1974).

Possible high-luminosity red stars in 15 galactic clusters with RA between 6 h and 11 h are discussed on the basis of UBVRI photometry. In a few cases cluster moduli are obtained from intermediate-band (Stroemgren) photometry of early-type stars. Several N-type stars are probable cluster members and confirm a previous conclusion that those in the very young-disk population are at M/sub Bol/ near -5 m and in the old-disk population are near M/sub Bol/ equals -3.5 m. (auth)

1685 MAGNETIC OBSERVATIONS OF WHITE DWARFS. Elias, J. H.; Greenstein, J. L. (California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 86: No. 514, 957-959(Dec 1974).

Observations of five DA white dwarfs made with a photographic Zeeman analyzer place upper limits on their longitudinal magnetic fields of the order of 10^5 gauss, consistent with previous observations. An upper limit of 7×10^5 gauss was determined for zH in the lambda 4135 A band of the lambda 4135 star Grw + $70^0$8247. (auth)

1686 SOME SPECTROSCOPIC PROPERTIES OF NOVA GK PERSEI. Gallagher, J. S.; Oinas, V. (Univ. of Nebraska, Lincoln). Publ. Astron. Soc. Pac.; 86: No. 514, 952-956(Dec 1974).

The late-type absorption spectrum of GK Per is classified K2 V-IVp from new spectroscopic observations in agreement with earlier work by Kraft. The fraction of continuum light contributed by the cool component at lambda 4200 is estimated to be about one-third from the depth of the Ca I lambda 4227 absorption line. By combining an effective temperature appropriate to the spectral class with an estimated absolute bolometric magnitude of 5, a radius of 1 to 1.5 R/sub mass/ is found. This is consistent with the photosphere of the cooler component filling its Roche lobe and thus mass exchange is likely to occur. GK Per therefore seems to fulfill at least one of the unusual prerequisites of thermonuclear runaway models for novae as matter is probably accreting onto the primary. The cool component of GK Per, unlike the late-type stars in other cataclysmic binaries, does not appear to be significantly underluminous. (auth)

1687 H ALPHA AND H BETA PHOTOMETRY OF 32 CYGNI. Guinan, E. F.; McCook, G. P. (Villanova Univ., PA). Publ. Astron. Soc. Pac.; 86: No. 514, 947-951(Dec 1974).

H alpha and H beta photoelectric observations of the long-period eclipsing binary 32 Cyg were obtained at Villanova University Observatory on 39 nights from 1971 to 1973. The data show previously unreported light variations outside of eclipse. Possible explanations of these variations are discussed. (auth)

1688 CAPTURE MODEL FOR THE FORMATION OF BINARY STARS AND BINARY GALAXIES. Byrd, G. G. Austin, TX; Univ. of Texas (1974). 169p. University Microfilms Order No. 75-4338.

Thesis (Ph. D.).

On the basis of current theoretical understanding of star cluster formation and observational evidence of disk-shaped nebulae around young stars, it is shown that the possibility of binary star formation via tidal interaction of such nebulae during close stellar encounters should be investigated. Such an investigation was carried out via computer models of parabolic encounters with each star surrounded by dynamically supported disk nebulae of mass equal to the stars'. Other trials were also run with a more conservative nebular mass of 0.1 that of the stars'. The computer model used can only handle two-dimensional configurations with the disk planes in the encounter orbit plane. Also valid results could be gathered only for limited amounts of tidal disruption of the nebulae. The model used a technique of calculating the gravitational field of a continuous disk that was recently proposed by Clutton-Brock. The computer model is also valid for showing what will happen during tidal encounters of galaxies, taking into account mass in the galactic disks. The model demonstrates that binary galaxies will form during parabolic encounters with disk collision, mass interchange, and high speed ejection of material occurring in the closer encounters. The success of the model in accounting for the observed characteristics of binary galaxies is presented. (Diss. Abstr. Int.)

1689 TEMPERATURE VARIATIONS IN HR 6684. Morton, A. E.; Hansen, H. K. (Brigham Young Univ., Provo, UT). Publ. Astron. Soc. Pac.; 86: No. 514, 943-946(Dec 1974).

Differential magnitude measurements of HR 6684 in ultraviolet and yellow light were made on four nights. An improved period of 0.1398903 d was determined with a total amplitude of 0.063 m in ultraviolet light and 0.028 m in yellow light. Using the amplitude difference of 0.035 m, a temperature variation of 900^0K +- 120^0K was found. (auth)

1690 ROTATIONAL VELOCITIES IN IC 2391. Levato, H. (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 86: No. 514, 940-942(Dec 1974).

Rotational velocities for 15 members of IC 2391 are provided. Their values show that on the average the members of IC 2391 rotate with a lower rate than field stars. (auth)

1691 SPECTROSCOPIC SURVEY OF SOME HIGH-LATITUDE BLUE VARIABLES. Bond, H. E. (Louisiana State Univ., Baton Rouge); Tifft, W. G. Publ. Astron. Soc. Pac.; 86: No. 514, 981-984(Dec 1974).

As part of a search for optically variable extragalactic objects, slit spectrograms of 32 high-galactic-latitude objects selected from the variable-star literature were obtained. One of the objects, V395 Her, is a distant galaxy, but its reported variability is questioned. The remaining objects are galactic variable stars; they include several eruptive variables, new RR Lyrae-type variables, and a variable white dwarf. (auth)

1692 ASTRONOMICAL WATER VAPOR MASERS. Kwok, S. Minneapolis; Univ. of Minnesota (1974). 127p. University Microfilms Order No. 75-2116.

Thesis (Ph. D.).

Water vapor maser emission was observed in many late type stars with expanding circumstellar envelopes. Under the assumption of collisional excitation, solutions are obtained for the thirty-one level water molecule radiative transfer problem. Model circumstellar envelopes for cool stars were also constructed in which dust grains condense and grow, and in which outflow is driven by radiation pressure. The expansion velocity as a function of distance is found for six sample stars and under different degrees of dust condensation. The OH and H_2O maser emission from these models are also predicted under simplifying assumptions. Observed features of relative line positions, angular distributions and OH line shapes are reproduced. Comparison of the model with optical observations show that in many Mira stars the optical absorption lines are red shifted in the scattering expanding envelopes by about 4 km/sec. In contrast with several recent interpretations, substantial parts of the receding envelope are seen by their maser emission. (Diss. Abstr. Int., B)

1693 ONE- AND TWO-ELECTRON ATOMS IN STRONG MAGNETIC FIELDS AND IMPLICATIONS FOR MAGNETIC WHITE DWARFS AND PULSARS. Surmelian, G. L. Baton Rouge, LA; Louisiana State Univ. (1974). 131p. University Microfilms Order No. 75-1954.

Thesis (Ph. D.).

A variational calculation is presented using Slater-type trial wave functions of the energy spectrum and ionization energy of the hydrogen atom in strong magnetic fields ranging from 10^6 Gauss (typical of magnetic white dwarf surfaces) to 10^{12} Gauss (typical of pulsar surfaces). In addition, bound-bound transition probabilities were calculated. Furthermore, a method is developed to generalize the energy level results to any one-electron atom. In particular, results for He II are presented. Also an exact calculation of the quadratic Zeeman wavelength displacements of the Balmer lines from DA white dwarfs is presented in view of which the estimate of the surface magnetic fields is higher than that obtained by previous, less accurate calculations. Finally the variational calculation is extended to two-electron atoms in strong magnetic fields: the energy spectrum and ionization energy of He I and the electron affinity of H^- are presented. (Diss. Abstr. Int., B)

1694 SEMINAR. Kantowski, R. pp 261-267 of Cargese Lectures in Physics, Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

A lecture is given on the effect of gravity on the polarization of electromagnetic waves coming from a collapsing star. In spite of the elegance of higher order optics calculations there seems to be no reasonable observation which can detect a correction to geometrical optics. The calculation shows that one does not see the effects at focus points and since the universe seems to have almost no shear, if any, one shouldn't see any effects in the remnants of the primeval fireball. (JFP)

1695 MAGNETIC FIELD AND RADIAL VELOCITY VARIATIONS OF A CENTAURI. Wolff, S. C.; Morrison, N. D. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 514, 935-939(Dec 1974).

Zeeman spectroscopic observations of the helium variable alpha Cen suggest that a magnetic field, varying between +1000 and -1000 gauss, is present in this star. Magnetic maximum coincides in phase with helium minimum. The radial velocity variations of the lines of He I are consistent with the hypothesis that the helium/hydrogen ratio varies over the surface of alpha Cen and that the helium spectrum variability is produced by rotation of this inhomogeneous surface. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 862–864, 905, 906, 908, and 910.

1696 1.2 mu TO 3.5 mu PHOTOMETRY OF EIGHT OPTICAL H II REGIONS. Persson, S. E.; Frogel, J. A. (Harvard College Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 514, 985-988(Dec 1974).

Infrared photometry from 1.2 mu to 3.5 mu for eight optical H II regions is presented. Light from the exciting stars affects the emission at the shorter wavelengths whereas at 3.5 mu there is excess emission from heated dust within the H II regions. In some of the objects there may be an excess even at 2.2. The distribution of the infrared flux implies that there are radial density gradients in the gas and dust distributions. In S 186 the dust emission, relative to that of the gas, increases toward the outside. (auth)

1697 PHOTOELECTRIC MONITORING OF BL LACERTAE. II. Milone, E. F. (Univ. of Calgary, Alberta). Publ. Astron. Soc. Pac.; 86: No. 514, 899-901(Dec 1974).

During June 1972 photoelectric photometry of BL Lac in visual light was carried out on the 127-cm and No. 2 91-cm telescopes at KPNO. The time available for this program was severely limited but sufficient to confirm the general character of the variation reported by the author in 1972, and by other authors. (auth)

1698 DIRECT ELECTRONOGRAPHIC OBSERVATIONS OF THE NEBULOSITY AROUND 3C 120. Walker, M. F. (Univ. of California, Santa Cruz); Pike, C. D.; McGee, J. D. Publ. Astron. Soc. Pac.; 86: No. 514, 870-872(Dec 1974).

Direct electronographic observations of 3C 120 with a Spectracon image converter mounted at the prime focus of the 120-inch reflector show that the bright, semistellar source is situated at the center of a smooth, elliptical nebulosity whose outer dimensions, at the level of 1.0 percent of sky, are 44" x 63", and whose mean color index is (B - V) equals +0.85 +- 0.15. These observations are consistent with the interpretation of N-type systems as quasi-stellar objects located at the center of elliptical galaxies. (auth)

1699 DEGREE OF OPTICAL VARIABILITY OF QUASI-STELLAR OBJECTS. Grandi, S. A.; Tifft, W. G. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 86: No. 514, 873-884 (Dec 1974).

Information on optical variability of quasi-stellar objects (QSOs) is collected and analyzed in order to determine the effect of variability on the data which have been utilized in various statistical arguments. It is found that photometric observations of QSOs are uncertain due to short-term variability by amounts up to 0.25 m to 0.50 m, with less than 10 percent of the QSOs being so variable that single measurements differ by 0.5 m. (auth)

1700 GAMMA RAY ASTRONOMY. Kniffen, D. (Goddard Space Flight Center, Greenbelt, MD). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 45-53(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Recent observations have marked the transition of gamma ray astronomy from a discovery phase to an exploratory one. This has been the result of the development of a number of very sophisticated sensitive telescopes and the opportunity to place them on space platforms. A survey of the instruments developed for this research is given together with a brief summary of the current status of the observational results. These include the studies of galactic gamma ray emission, the diffuse, presumably extragalactic gamma radiation and localized gamma ray sources. The study of the spatial distribution of galactic gamma radiation is beginning to provide a new means for the study of galactic structure and dynamics. The diffuse emission may provide evidence of gamma ray emission in the cosmological past, although improved observations must be obtained before the picture can be clarified. The study of localized sources has shown NP0532, the Crab radio pulsar, to be a gamma ray pulsar also and strong emission from Vela may be due to supernova produced cosmic rays interacting with the remnant gas. (auth)

Solar Phenomena

Refer also to abstracts 860, 1658, 1740, and 1743.

1701 (CONF-7209115-) PROCEEDINGS OF THE THIRD MEETING OF THE COMMITTEE OF EUROPEAN SOLAR RADIO ASTRONOMERS (C.E.S.R.A.) HELD AT BOURDEAUX-FLOIRAC 21–22 SEPTEMBER 1972. Delannoy, J.; Poumeyrol, F. (Eds.). (Bordeaux Univ., 33 Floirac (France). Observatoire). 1973. 226p.

From 3rd meeting of the Committee of European Solar Radio Astronomers; Bordeaux, France (21 Sep 1972).

• The conference included 25 papers on solar radiation and activity and radioheliographs. (JFP)

1702 (N-74-26264) CATALOGUE OF SOLAR COSMIC-RAY EVENTS: IMPS 4 AND 5, MAY 1967–DECEMBER 1972. Van Hollebeke, M. A.; Wang, J. R.; McDonald, F. B. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jan. 1974. 216p. (NASA-TM-X-70629; X-661-74-27). NTIS $5.75.

This catalog of solar cosmic ray events was prepared for the use of solar physicists and other interested scientists. It contains some 185 solar particle events detected by the Goddard Space Flight Center Cosmic Ray Experiments on IMP's IV and V (Explorer 34 and 41) for the period May 1967–December 1972. The data are presented in the form of hourly averages for three proton energy intervals, 0.9 to 1.6 MeV; 6 to 20 MeV and 20 to 80 MeV. In addition the time histories of 1.5 to 1.1 MeV electrons are shown on a separate scale. To assist in the identification of related solar events, the onset time of the electron event is indicated. The details of the instrumentation and detector techniques are described. Further descriptions of data reduction procedure and on the time-history plots are given. (STAR)

1703 (N-74-26266) SPECTRAL IRRADIANCE CURVE CALCULATIONS FOR ANY TYPE OF SOLAR ECLIPSE. Deepak, A.; Merrill, J. E. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). 1 Feb 1974. 26p. (NASA-TM-X-64842). NTIS $3.25.

A simple procedure is described for calculating the eclipse function (EF), alpha, and hence the spectral irradiance curve (SIC), (1-alpha), for any type of solar eclipse: namely, the occultation (partial/total) eclipse and the transit (partial/annular) eclipse. The SIC (or the EF) gives the variation of the amount (or the loss) of solar radiation of a given wavelength reaching a distant observer for various positions of the moon across the sun. The scheme is based on the theory of light curves of eclipsing binaries, the results of which are tabulated in Merrill's Tables, and is valid for all wavelengths for which the solar limb-darkening obeys the cosine law: J equals /sub c/(1 - X + X cost gamma). As an example of computing the SIC for an occultation eclipse which may be total, the calculations for the March 7, 1970, eclipse are described in detail. (STAR)

1704 (N-74-26276) HIGH-ENERGY PARTICLES ASSOCIATED WITH SOLAR FLARES. Sakurai, K.; Klimas, A. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1974. 187p. (NASA-TM-X-70655; X-693-74-116). NTIS $12.50.

High energy particles, the so-called solar cosmic rays, are often generated in association with solar flares, and then emitted into interplanetary space. These particles, consisting of electrons, protons, and other heavier nuclei, including the iron-group, are accelerated in the vicinity of the flare. By studying the temporal and spatial variation of these particles

near the earth's orbit, their storage and release mechanisms in the solar corona and their propagation mechanism can be understood. The details of the nuclear composition and the rigidity spectrum for each nuclear component of the solar cosmic rays are important for investigating the acceleration mechanism in solar flares. The timing and efficiency of the acceleration process can also be investigated by using this information. These problems are described in some detail by using observational results on solar cosmic rays and associated phenomena. (STAR)

1705 (N-74-30259) ENERGETIC SOLAR PROTON VERSUS TERRESTRIALLY TRAPPED PROTON FLUXES FOR THE ACTIVE YEARS, 1977–1983. King, J. H.; Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1974. 15p. (NASA-TM-X-70716; X-601-74-221). NTIS $4.00.

Ratios of solar to trapped proton fluences were computed for circular-orbit, geocentric space missions to be flown during the active phase of the next solar cycle (1977–1983). The ratios are presented as functions of orbit altitude and inclination, mission duration, proton energy threshold, and the chance the mission planner is willing to take that the actually encountered solar proton fluence will exceed the design fluence provided by the statistical solar proton model. It is shown that the ratio is most sensitively dependent on orbit altitude and inclination, with trapped protons dominant for low inclination, low and mid altitude orbits and for high inclination, mid altitude orbits. Conversely, solar protons are dominant for high inclination, low altitude orbits, and for low and high inclination, high altitude orbits. (STAR)

1706 (N-74-32238) SOLAR NEUTRINOS AND THE INFLUENCE OF RADIATIVE OPACITIES ON SOLAR MODELS. Carson, T. R.; Ezer, D.; Stothers, R. (National Aeronautics and Space Administration, New York (USA). Goddard Inst. for Space Studies). 1973. 8p. (NASA-TM-X-70321). NTIS $4.00.

Use of new radiative opacities based on the hot Thomas–Fermi model of the atom yields a predicted solar neutrino flux which is still considerably larger than the flux observed in Davis' Cl-37 experiment. (STAR)

1707 STUDIES OF SOFT X-RAY EMISSION DURING SOLAR FLARES. Anandaram, M. N. Victoria, B. C.; Victoria Univ. (1974). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

Solar flare soft x-ray emission from 0.5 to 8.5 Å was observed during 1967–68 by U. S. Naval Research Laboratory Bragg crystal (LiF and EDDT) spectrometers aboard the OSO-4 satellite and also by NRL broad band ionization detectors aboard the OGO-4 satellite. Instrumental parameters for the LiF crystal spectrometer based on experimental values were determined and used in the data analysis. The source continuum spectra between 1 and 3.8 Å were obtained for selected flares from OSO-4 spectrometer scans. As these spectra are each affected by time variations over 14 minutes, they are compared with the thermal continuum (free-free and free-bound) spectra predicted in the following manner. The instantaneous electron kinetic temperature and emission measure (equal to the product of the square of the electron number density and the total volume) of the flare plasma are determined from the available OGO-4 broad band data. The expected continuum flux is calculated by using these parameters. The comparison shows that there is good agreement between 2 and 3.8 Å. Thus it was concluded that reliable values of the average electron temperature can be determined from the OGO-4 flare data. (Diss. Abstr. Int., B)

1708 CONDENSATION TIME OF THE SOLAR NEBULA FROM EXTINCT ^{129}I IN PRIMITIVE METEORITES. Lewis, R. S.; Anders, E. (Univ. of Chicago). Proc. Nat. Acad. Sci. U.S.A.; 72: No. 1, 268-273(Jan 1975).

Mineral separates from five carbonaceous chondrites were dated by extinct 16 million year ^{129}I, in an attempt to establish the condensation time of the solar nebula. Two Fe_3O_4 or Fe_3O_4-FeS samples from the Murchison and Orgueil meteorites are older than any other material dated thus far, and apparently formed within 2×10^6 years of each other. The great age, close isochronism, and primitive nature of the samples suggest that the event recorded was the condensation stage of the solar nebula. It provides a suitable zero point for the chronology of the early solar system. The $^{129}I/^{127}I$ ratio during condensation of the nebula was $(1.46 \pm 0.04) \times 10^{-4}$. The recrystallized C4 chondrite Karoonda began to retain ^{129}Xe 1.8 ± 0.5 million years after the above event. This short cooling time implies rapid accretion (less than or equal to 1 million years) and a shallow origin (less than or equal to 10 km) below the surface of its parent body. (auth)

1709 SEARCH FOR SOLAR PARTICLE PRODUCTION ABOVE APPROX. 75 GeV. Schindler, S. M. Fort Collins, CO; Colorado State Univ. (1974). 278p. University Microfilms Order No. 75-4614.

Thesis (Ph. D.)

An experiment was constructed to investigate the possibility of solar particle production in the energy region above approximately 75 GeV as predicted in the work of Friedman and Hamberger and S. I. Syrovatskii. A narrow-angle muon telescope (geometric factor: 6.95 cm^2-sterad; opening angle: 12.6 deg), capable of maintaining continuous orientation with respect to a highly anisotropic particle flux, was employed in the research. For specific resolution of a very high energy solar particle component, the detecting system was located underground at a nominal vertical depth of 200 mwe. The experiment was housed in the Colorado School of Mines Experimental Mine, Idaho Springs, Colorado (geographic longitude: 105.6 deg W; geographic latitude: N39.7 deg; elevation: 8210 ft above sea level). After approximately 2,500 hours of initial operation, a positive correlation was obtained between a significant intensity increase and a specific solar event. The event of interest was an M8, importance 2N/2B flare which took place at approximately 1330 UT on 3 October 1971. Analysis of the event leads to an interpretation of the results in terms of a flare-generated particle component of energy greater than or equal to 75 GeV. The detected event is best described in terms of a short-period or impulsive mechanism, capable of achieving cosmic ray energies in times of order less than or equal to 10 min. The results are consistent with high energy particle acceleration being confined mainly to the early phase of flare development, and prior to the H/sub alpha/ maximum. This description is in agreement with past interpretations of solar particle events obtained using indirect methods based on nonthermal emission characteristics. The results of a statistical analysis (small-intensity study) of approximately 6,300 hours of selected data for the period March 1971 to June 1972 (excluding the 3 October 1971 event) support the results found for the 3 October flare. These results are consistent with very high energy solar particle production taking place in association with the larger solar flares (Class greater than or equal to M1; Importance greater than or equal to 1). (Diss. Abstr. Int., B)

1710 WHITE LIGHT CORONAGRAPH IN OSO–7. Koomen, M.J.; Detwiler, C.R.; Brueckner, G.E.; Cooper, H.W.; Tousey, R. (E. O. Hulburt Center for Space Research, U.S. Naval Research Laboratory, Washington, D.C. 20375). Appl. Opt. 14: No. 3, 743-751 (Mar 1975).

A small, externally occulted Lyot-type coronagraph, designated for use in the seventh unmanned Orbiting Solar Observatory (OSO-7), is described. Optical configuration, suppression of stray light, SEC vidicon detector, and data system are discussed, as well as integration of the instrument into the spacecraft and operation in orbit. Orbital operation produced daily images of the white light corona, from 2.8 to 10 solar radii, at least once per day for 2 3/4 yr. The first records of white light coronal transient events were obtained, and the corona was shown to be constantly changing. (auth)

1711 RECENT MEASUREMENTS OF THE FLUX EXCESS FROM SOLAR FACULAE AND THE IMPLICATION FOR THE SOLAR OBLATENESS. Chapman, G.A. (San Fernando Observatory, Space Physics Laboratory, The Aerospace Corporation, Los Angeles, California 90009). Phys. Rev. Lett. 34: No. 12, 755-758 (24 Mar 1975).

Direct observation of the excess brightness from photospheric faculae are presented. This excess brightness is, at times, large enough to produce an apparent oblateness that exceeds that reported by Dicke and Goldenberg. These results support the Chapman-Ingersoll facular explanation for the excess solar oblateness and support the findings of Hill *et al.* by offering a possible source for their excess equatorial brightness which, they showed, can produce an apparent, nongeometrical oblateness. (auth)

1712 SOLAR LINE PROFILES OF He I 584 A AND He II 304 A. Cushman, G.W.; Farwell, L.; Godden, G.; Rense, W.A. (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado 80302). J. Geophys. Res. 80: No. 4, 482-486 (1 Feb 1975).

A grazing incidence spectrograph launched in a Black Brant rocket August 30, 1973, at White Sands Missile Range obtained high spectral resolution data of the solar radiation between 200 and 700 A. Absolute intensities and profiles of the brighter lines in this spectral region were measured. Results for the He I 584–A and He II 304–A lines are presented. For the He I 584–A line the full width at half intensity is 0.08 A, and the intensity for the solar disk is 1.3×10^9 photons cm^{-2} s^{-1}. For the 304–A He II line these values are 0.12 A and 6.3×10^9 photons cm^{-2} s^{-1}, respectively. (auth)

1713 THE EFFECT OF ASYMMETRIC SOLAR WIND ON THE LYMAN α SKY BACKGROUND. Joselyn, J.A. (NOAA Environmental Research Laboratories, Space Environment Laboratory, Boulder, Colorado 80302); Holzer, T.E. J. Geophys. Res. 80: No. 7, 903-907 (1 Mar 1975).

The Lyman α (Ly α) sky background arises from the scattering of solar Ly α from a spatial distribution of neutral hydrogen in interplanetary space. This distribution is partially determined by the solar wind proton flux, which provides the principal mechanism of loss by charge exchange of the neutral hydrogen. By generating isophotal maps of scattered Ly α for several choices of interstellar wind direction and solar wind proton flux distributions, the results show that latitudinal variations of the solar wind proton flux can have a significant effect on the observed location and shape of the Ly α intensity maximum. This fact should aid in the interpretation of Ly α maps and also indicates a possible method for inferring values for the average solar wind proton flux out of the ecliptic plane. (auth)

1714 ALFVÉN WAVE REFRACTION IN HIGH-SPEED SOLAR WIND STREAMS. Hollweg, J.V. (High Altitude Observatroy, National Center for Atmospheric Research, Boulder, Colorado 80302). J. Geophys. Res. 80: No. 7, 908-916 (1 Mar 1975).

We use a simple physical theory to calculate the variation of Alfvén wave amplitudes and the wave refraction in a schematic model for a high-speed solar wind stream. The results are as follows. (1) The wave amplitudes $(\delta B^2)^{1/2}$ are larger in the compression region of the stream than in the rarefaction region. (2) The relative amplitudes $(\delta B^2)^{1/2}/B_0$ are larger in the rarefraction region than in the compression region, this result indicating that nonlinear effects may be more important in the rarefaction region. (3) The azimuthal velocity gradient in the stream leads to the result that k is no longer nearly radial at 1 AU, in contrast to predictions based on a spherically symmetric solar wind structure. In the rarefraction region, k turns into the direction of B_0, whereas in the compression region, k turns away from the direction of B_0. This predicted result in the rarefraction agrees with direct in situ observations at 1 AU. (4) Waves that start near the sun with different k all tend to be refracted into the same direction by the time that they reach 0.5 AU. This result indicates that plane wave analyses will be appropriate beyond 0.5 AU. (auth)

1715 MULTISPACECRAFT STUDY OF THE SOLAR WIND VELOCITY AT INTERPLANETARY SECTOR BOUNDARIES. Rhodes, E.J. Jr.; Smith, E.J. (Jet Propulsion Laboratory, Pasadena, California 91103). J. Geophys. Res. 80: No. 7, 917-928 (1 Mar 1975).

The sector structure of the interplanetary magnetic field and the solar wind velocity at the sector boundaries have been compared at two widely separated locations. Magnetic field and solar wind velocity observations made aboard Mariner 5 en route to Venus and with the near-earth satellites Explorer 33, 34, and 35 have been compared at separations of up to 0.3 AU, 50° in heliocentric longitude and 7° in heliographic latitude. The polarity pattern of the magnetic sectors was found to be very similar at the two locations, and 18 pairs of corresponding sector boundaries were identified. These sector boundaries were used to identify corresponding portions of the solar wind at each spacecraft so that their velocities could be compared. One-hour averages of the velocities in the vicinity of the sector boundaries showed the velocities to be systematically different. The velocities at earth exceeded those at Mariner 5 by as much as 30% (or 120 km/s). Instrumental effects and measurement errors were considered but rejected as potential causes of the velocity differences. Temporal variations of the solar source of the plasma and an overall radial acceleration of the solar wind were also rejected on both theoretical and observational grounds. The most plausible explanations of the observed velocity differences are (1) a preferential acceleration of sector boundaries with distance, perhaps caused by stream-stream interactions: or (2) a dependence of the solar wind velocity on heliographic latitude. The second explanation is consistent with the evidence of a possible latitude dependence in the solar wind velocity inferred from an analysis of Vela satellite data by Hundhausen et al. (1971). Both sets of data imply a gradient of $\simeq$10 km/s per degree of latitude. (auth)

1716 RESPONSE OF THE PLASMA SHEET AT ~18 R_E TO SUDDEN SOUTHWARD TURNINGS OF THE INTERPLANETARY MAGNETIC FIELD. Lui, A.T.Y.; Hones, E.W. Jr.; Venkatesan, D.; Akasofu, S.; Bame, S.J. J. Geophys. Res. 80: No. 7, 929-935 (1 Mar 1975).

Simultaneous measurements of the interplanetary magnetic field (IMF) by Explorer 35 and of the magnetotail plasma by Vela satellites are examined for the period August–October 1970. Nineteen cases are found in which the IMF turns southward more than 40° ($|\Delta\theta| > 40°$) in less than 10 min and Vela satellite, operating in a high time resolution mode, is in the plasma sheet. Twelve of these cases show a large decrease of plasma pressure, or the so-called plasma sheet thinning, during the subsequent period of southward IMF. Polar magnetic substorms occur at the earth in conjunction with these twelve plasma sheet thinnings. On the other hand, seven cases show only slight plasma sheet thinnings, and there was no indication of substorms at the standard auroral zone stations. Thus it is likely that the southward IMF alone does not reduce significantly plasma pressure in the plasma sheet and that a large decrease of plasma pressure is associated with a substorm. (auth)

1717 THE ENHANCEMENT OF SOLAR WIND FLUCTUATIONS AT THE PROTON THERMAL GYRORADIUS. Neugebauer, M. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Geophys. Res. 80: No. 7, 998-1002 (1 Mar 1975).

Average power spectra of solar wind fluctuations at frequencies up to 0.87 Hz are calculated from Ogo 5 measurements of positive ion flux. Although the general spectral trend follows the power law spectrum observed at lower frequencies, a small but statistically significant power enhancement is observed at the frequency $\nu/2\pi R$ where ν is the solar wind velocity and $R = (2mkT)^{1/2}/eB$ is the gyro radius of proton thermal motions in the solar wind. The measured power spectrum is in rough agreement with that deduced from radio scintillation observations. (auth)

Galaxies

Refer also to abstracts 1688 and 1734.

1718 1667 MHz OH ABSORPTION SURVEY OF THE SOUTHERN MILKY WAY. Caswell, J. L.; Robinson, B. J. (CSIRO, Epping, Australia). Aust. J. Phys.; 27: No. 4, 597-627(Aug 1974).

A search was made at 1667 MHz for OH absorption against 105 strong continuum sources in the region $265 < l < 352°$, and data are presented for 33 sources showing absorption. The overall distribution of OH absorption in this galactic longitude range was investigated by combining these results with measurements on 11 additional sources studied in earlier searches. Many of the sources showing 1667 MHz absorption were observed at the other three 18 cm OH transitions, and as a result 14 new satellite-line emission sources were found. (auth)

1719 2700 MHz POLARIZATION OBSERVATIONS OF 17 SUPERNOVA REMNANTS. Milne, D. K. (CSIRO, Epping, Australia); Dickel, J. R. Aust. J. Phys.; 27: No. 4, 549-562(Aug 1974).

Maps are presented of the polarization and total-power emission at 2700 MHz from 17 supernova remnants, including the Monoceros nebula, the Lupus loop and W44. Directions of the magnetic field and values of the rotation measure are deduced for W44 by combining 2700 and 5000 MHz observations. (auth)

1720 APPARENT LUMINOSITY FUNCTION OF GALAXIES TO THE TWENTY-FIRST MAGNITUDE. Brown, G. S. Austin, TX; Univ. of Texas (1974). 161p. University Microfilms Order No. 75-4335.

Thesis (Ph. D.).

The galaxy distribution was probed in depth by counts to several limiting magnitudes rather than survey a large area at the same limiting magnitude. To this end, a reducing camera was built and used at the Casse-grain foci of the 36- and 82-inch telescopes at McDonald Observatory. Photographs were taken of 13 fields in the north galactic polar cap, each field covering 0.346 square degree (36-inch) and 0.066 square degree (82-inch). Exposures of 10, 30, and 90 minutes were made in each area with the 36-inch and 90 minutes with the 82-inch, giving approximate limiting magnitudes of 18, 19, 20 and 21. Galaxies and stars were counted through a binocular microscope by laying a counting grid over the plates. A decision was made as to whether each object was a galaxy or a star and its identity and position within a counting square plotted on a large scale chart of each plate. Since the four plates for each area were approximately concentric, this made possible checks on the identity of objects on each 36-inch plate by a deeper plate. The limiting magnitude of each plate was obtained by a combination of photoelectric and photographic photometry. Four standard stars (12 to 14 mag.) were measured photoelectrically in each area. A computer model for fixed aperture "Schilt type" photographic photometry was written and used to extrapolate from the photoelectric standards to the plate limit. As a check pulse count photometry was done with the 82-inch telescope on faint stars and galaxies in three of the photographed areas. The apparent luminosity function for galaxies (B equals 17.7 to 21.0) so derived was compared with results from others. A computer model for the apparent luminosity function was written, following Mattig. It integrates over the absolute luminosity function of the types of galaxies most likely to have been counted, and includes type-dependent K-corrections. The model, calculated for various values of the deceleration parameter, is compared with means of data from all sources. The effects of galaxy evolution and intergalactic extinction are considered. Also additional evidence is provided that galaxies are not distributed homogeneously in depth and it is indicated that models which assume homogeneity may have to be rejected in favor of models which take into account large scale density fluctuations. (Diss. Abstr. Int., B)

1721 H II REGIONS IN GALAXIES. Hodge, P. W. (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 86: No. 514, 845-860(Dec 1974).

This is a review of the current status of the study of H II regions in other galaxies, especially of their spatial distribution and relation to galactic structure. An extensive table compiles all available data on the H alpha surveys of galaxies. (auth)

1722 FURTHER OBSERVATIONS OF THE NUCLEAR ROTATION IN M31. Walker, M. F. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 86: No. 514, 861-866(Dec 1974).

Radial-velocity observations of the nucleus of M31 obtained with the Lallemand electronic camera and 120-inch coude spectrograph and with the prime-focus nebular spectrograph are presented. These observations cover the range 0" less than or equal to r less than or equal to 24" and show that the rotation curve, which has its maximum amplitude in P.A. equals 52^0, increases linearly from zero at r equals 0 to V/sub c/ equals 104 km sec^{-1} at r equals 1.9", beyond which it drops approximately as V/sub c/ varies as r/sup -½/. After making approximate correction for the effect of seeing and instrumental resolution the radius of the nucleus r equals 1.55" or 5.2 pc, a rotational period of 3.1×10^5 years, and a mass of 1.6×10^8 m/sub mass/are found. (auth)

1723 PRIMORDIAL TURBULENCE AND INTERGALACTIC MATTER. Silk, J. (Univ. of California, Berkeley). pp 401-503 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The discussion of primordial turbulence and intergalactic matter covers galaxy formation, Friedman cosmologies, the initial energy spectrum of galaxies, intergalactic cosmic rays, and intergalactic matter. (JFP)

1724 GALAXY FORMATION AND THE EARLY UNIVERSE. Harrison, E. R. (Univ. of Massachusetts, Amherst). pp 581-641 of Cargese Lectures in Physics. Vol. 6. Schartzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The discussion of galaxy formation and the early universe covers cosmological and cosmogonical assumptions, the early universe, initial conditions of galaxy formation, observed properties of galaxies, gravitational instability, galactic rotation, and spinning core theory. (JFP)

1725 EVOLUTIONARY EFFECTS ON RADIALLY VARYING PROPERTIES OF COMA CLUSTER GALAXIES. Gregory, S. A. Tucson, AZ; Univ. of Arizona (1974). 80p. University Microfilms Order No. 75-4111.

Thesis (Ph. D.)

A sample of galaxies brighter than m/sub p/ equals 15.7 out to a radial distance of 2.79^0 from the Coma cluster center is essentially completed by new observations of redshifts, morphology, and color. The redshift results show that the velocity dispersion first decreases and then increases again with distance from the center. The mean velocity dispersion is found to be 712 Km sec^{-1} in the line of sight. A marginally positive test for solid body rotation of 86 +- 66 Km sec^{-1} $degree^{-1}$ is also found. The morphology and color data show two interesting features. First, the relative number of spiral and irregular galaxies is shown to increase with radial distance. Secondly, E and SO galaxies located far from the cluster center appear to be bluer than those near the center. These observations are discussed in terms of two theories of cluster formation and are shown to be consistent with numerical models of the collapse of axisymmetric rotating systems in which star formation had already occurred at the time of maximum cluster radius. The results are also consistent with the existence of an intracluster medium which forms SO's out of spiral galaxies and reddens the central galaxies by a few hundredths of a magnitude in B-V. (Diss. Abstr. Int., B)

Cosmology

Refer also to abstracts 1724 and 1862.

1726 GRAVITATING NEUTRONS-EQUILIBRIUM AND MICROSCOPIC STABILITY. Hillebrandt, W. Cologne; Univ. Cologne (1973). 43p. (In German). INIS.

Thesis.

By means of an ideal neutron star model, it is shown that nuclear forces and gravitation balance out in calculating the ground state as well as regarding stability investigations. A method has thus been developed to enable the equilibrium configuration of a neutron star to fixed particle number N to be determined without firstly calculating a state equation. For this model, the saturation behavior at N → infinitely was further investigated. It was found that the nuclear forces do, in fact, lower the degree of nonsaturation of a gravitating system; they cannot, however, bring about saturation. Sufficient criteria for the instability of the Hartree-Fock ground state of neutron matter against microscopic density fluctuations were derived from the equations of the second variation. The application of one of these criteria to two effective two-particle potentials constructed by different methods resulted in instability for each density of the system. (GE)

1727 COSMOLOGICAL MODEL OF CLASS ONE IN LYRA'S MANIFOLD. Bhamra, K. S. (Indian Inst. of Tech., Kharagpur). Aust. J. Phys.; 27: No. 4, 541-547(Aug 1974).

A study is presented of a spherically symmetric class-one cosmological model based on Lyra's geometry. The static universe is shown to be physically unrealistic. The nonstatic model parallels Lemaitre's in the Riemannian case but the law of mass-energy conservation does not hold. (auth)

1728 MODEL UNIVERSES WITH A HUBBLE CONSTANT OF 53 KM SEC^{-1} MPC^{-1}. Omer, G. C. Jr.; Green, F. R. (Univ. of Florida, Gainesville). Publ. Astron. Soc. Pac.; 86: No. 514, 867-869(Dec 1974).

General relativistic models filled with dust were calculated with Sandage's new value for the Hubble constant of 53 km sec^{-1} Mpc^{-1}. Possible discrepancies between the present values of the average density of matter, the calculated ages of the models, and the preferred values of the deceleration parameter are discussed. The apparent contradictions can be reduced by using a small negative value for the cosmological constant. (auth)

1729 FORMATION OF PLANETARY NEBULAE. Stry, P. E. Boulder, CO; Univ. of Colorado (1974). 84p. University Microfilms Order No. 75-3838.

Thesis (Ph. D.)

Both direct and indirect observations of planetary nebulae and their central stars imply that their precursors were red supergiant stars with total masses of about 1.2M/sub mass/ and envelope masses of about 0.2M/sub mass/. Because of their huge radii these envelopes are only loosely bound and a large number of mechanisms have been proposed to explain their ejection and the consequent formation of planetary nebulae. This work was undertaken to help choose between these many competing theories. First a grid of envelope models was constructed spanning the red supergiant region, each corresponding to total mass 1.2M/sub mass/. From these a series of 'optimum' models with 0.2M/sub mass/ envelopes was interpolated extending from L equals 10,000L/sub mass/ up to nearly the critical luminosity. These were tested for linear instabilities. The first and second harmonics were found to be overstable as expected with periods characteristic of Miras. No dynamical instability was found and in particular the fundamental was found to join the secular roots on the stable real axis. This can be explained by a simple analogy. Since the linear results gave no definite answer, nonlinear calculations were undertaken on the model envelope with luminosity just below the critical luminosity. Previously the most luminous models tested nonlinearly for envelope ejection were at about one-half the critical luminosity where three different authors got two different results. A luminosity perturbation at the inner boundary consisting of raising the luminosity boundary condition 10 percent to about the critical luminosity resulted in the envelope being ejected after three halves of an oscillation. This permits one to draw the conclusion that the mechanism of ejection by radiation pressure when the luminosity reaches the critical luminosity is sufficient to explain the formation of planetary nebulae. Envelope ejection will be the result, not relaxation oscillations. While this does not rule out the possibility of some other mechanism operating first as the star ascends the asymptotic branch, it provides a sufficient and ultimately inescapable process for the formation of planetary nebulae. (Diss. Abstr. Int., B)

1730 CARGESE LECTURES IN PHYSICS. Volume 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 736p. $49.50.

Separate abstracts were prepared for the 10 papers presented. (JFP)

For abstracts of individual lectures see: 1694, 1723, 1724, 1731-1736, and 1862.

1731 RELATIVISTIC COSMOLOGY. Ellis, G. F. R. (Cambridge Univ., Eng.). pp 1-60 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The lectures on relativistic cosmology cover local physics and cosmology, space-time splitting, conservation of energy and momentum, the field equations, observations, and the observable universe. (JFP)

1732 COSMOLOGICAL MODELS FROM A GEOMETRIC POINT OF VIEW. MacCallum, M. A. H. (Cambridge Univ., Eng.). pp 61-174 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Lectures are presented providing an introduction to some geometrical methods as applied to cosmology and reviewing present knowledge of cosmological models from a geometric point of view. The coverage includes continuous symmetry groups, geometric techniques and the field equations, spatially homogeneous universes, and the early universe and chaotic coupling. (JFP)

1733 RELATIVISTIC THERMODYNAMICS AND KINETIC THEORY, WITH APPLICATIONS TO COSMOLOGY. Stewart, J. M. (Inst. of Theoretical Astronomy, Cambridge, Eng.). pp 175-226 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The discussion of relativistic thermodynamics and kinetic theory with applications to cosmology also covers the fundamentals and nonequilibrium relativistic kinetic theory and applications to cosmology and astrophysics. (JFP)

1734 TYPE I COSMOLOGIES. Shepley, L. C. (Univ. of Texas, Austin). pp 227-260 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The anisotropic cosmologies invariant under a three-dimensional abelian group of isometries, transitive on spacelike hypersurfaces are studied. The solution of Einstein field equations for various types of postulated matter content, the description and decay of anisotropy, and the behavior of perturbations as connected with the creation of galaxies. (JFP)

1735 OBSERVATIONAL COSMOLOGY. Longair, M. S.; Rees, M. J. (Inst. of Theoretical Astronomy, Cambridge, Eng.). pp 269-400 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The essential features of the various cosmological models, tests, and observations are emphasized. The discussion covers the contents of the universe—local cosmological problems, general principles and the assumptions of classical cosmology, survey of useful results for comparing theory and observation, the classical cosmological tests, the background radiation, and the thermal history of the big bang universe, the intergalactic gas, and nucleosynthesis in the primordial fireball. (JFP)

1736 CASE AGAINST ANTIMATTER IN THE UNIVERSE. Steigman, G. (California Inst. of Tech., Pasadena). pp 505-579 of Cargese Lectures in Physics. Vol. 6. Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Lectures are given on evidence for the material content of the universe. For the massive particles, that is, nucleons and leptons, the ratio of antiparticles to particles is discussed. The Robertson–Walker–Friedmann models, thermal history of the early universe, the difficulties with symmetric cosmologies, and observational evidence are considered. It is concluded that the galaxy contains very little if any antimatter. (JFP)

1737 COSMOLOGY AND THE HIGGS MASS. Veltman, M. (Institute for Theoretical Physics, University of Utrecht, Utrecht, Netherlands). Phys. Rev. Lett. 34: No. 12, 777-777 (24 Mar 1975).

It is demonstrated that a very small or zero Higgs mass is excluded by experiment. (auth)

Planetary Phenomena

Refer also to abstracts 1670 and 1671.

1738 (N-74-30291) HYDROGEN AND FLUORINE IN THE SURFACES OF LUNAR SAMPLES. Leich, D. A.; Goldberg, R. H.; Burnett, D. S.; Tombrello, T. A. (California Inst. of Tech., Pasadena (USA)). Apr 1974. 30p. (NASA-CR-139299). NTIS $4.50.

The resonant nuclear reaction F-19 (p, alpha gamma)O-16 was used to perform depth sensitive analyses for both fluorine and hydrogen in lunar samples. The resonance at 0.83 MeV (center-of-mass) in this reaction was applied to the measurement of the distribution of trapped solar protons in lunar samples to depths of about ½ micrometer. These results are interpreted in terms of terrestrial H_2O surface contamination and a redistribution of the implanted solar H which has been influenced by heavy radiation damage in the surface region. Results are also presented for an experiment to test the penetration of H_2O into laboratory glass samples which have been irradiated with O-16 to simulate the radiation damaged surfaces of lunar glasses. Fluorine determinations were performed in a 1 pm surface layer on lunar samples using the same F-19(alpha gamma)O-16 resonance. The data are discussed from the standpoint of lunar fluorine and Teflon contamination. (STAR)

1739 RARE GASES IN APOLLO 11 FINES. Basford, J. R. Minneapolis; Univ. of Minnesota (1974). 124p. University Microfilms Order No. 75-2085.

Thesis (Ph. D.)

The history of Mare Tranquillitatus regolith is studied with rare gas and mass spectrometric techniques. Grain size-ordinate intercept analyses are applied to bulk soil, ilmenite and plagioclase size separates obtained from less than 1 mm fines sample 10084,48. Thermal release of a less than 1 mu total soil size separate is also examined in a step heating experiment. Carbide, methane and rare gas contents in an organic aliquot of 10084 (10086D) are analyzed and discussed. He, Ne, Ar, Kr and Xe concentrations and compositions have been determined for all the grain size and temperature examinations performed. K, Rb, Sr, and Ba concentrations were measured in aliquots of these samples. The results for the 10086D examinations are reported in terms of carbide, methane and rare gas concentrations only. (Diss. Abstr. Int., B)

1740 STRUCTURE AND VARIATIONS OF SOLAR WIND-MARS INTERACTION REGION. Bogdanov, A.V.; Vaisberg, O.L. (Space Research Institute, Academy of Sciences of the USSR, Moscow, USSR). J. Geophys. Res. 80: No. 4, 487-494 (1 Feb 1975).

Measurements of ion fluxes in close vicinity to Mars have been made by the space probes Mars 2 and Mars 3 during 1971–1972. Analysis of measurements confirms the earlier preliminary conclusion by these authors about the existence of bow shock wave near Mars. Seventeen crossings of the bow shock are used to obtain the mean location of the bow shock and to estimate the dimension of the obstacle. The mean distance to the bow shock subsolar point is estimated as ~1200 km, and the corresponding height of the stagnation point, as ~400 km. Anomalously far positions of bow shock, ~2800 km, have been observed by the two satellites. New features of the interaction region have been observed. This region is characterized by high-intensity fluxes of ions with temperatures of some tens of electron volts and convective velocities well below the convective velocity in the magnetosheath. This 'cushion' of hot ions is situated inside the magnetosheath but above the Martian ionosphere. Intercomparison of these measurements with magnetic field data shows that observations of decelerated hot ions usually coincide with an increase of the magnetic field up to 15–30 γ. A gradual change of the ion transport velocity at the transition from the magnetosheath to the cushion of hot ions favors the piling up model of magnetic field rather than the model of the internal dipole field of Mars. (auth)

1741 PHOTOELECTRON ESCAPE FROM THE IONOSPHERE OF JUPITER. Swartz, W.E.; Reed, R.W.; McDonough, T.R. (School of Electrical Engineering, Cornell University, Ithaca, New York 14853). J. Geophys. Res. 80: No. 4, 495-501 (1 Feb 1975).

Photoelectron escape fluxes and ambient electron heating from the Jovian ionosphere are computed as a function of local time and latitude. Several differences for the fluxes expected from a hydrogen atmosphere, rather than a terrestrial type of atmosphere, are described, including an increase in structure in the energy spectra due to the paucity of ionic states entering the photo-ionization processes and lower escape fluxes above 10 eV than were expected from a simple scaling of earth fluxes. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 307, 907, 1759, and 1821.

1742 (BNWL-SA-5177) RELATIONSHIP OF STABLE AURORAL RED ARCS TO THE PLASMAPAUSE. Kleckner, E. W.; Smith, L. L.; Wildman, P. J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 1974. 3p. (CONF-741203-3). Dep. NTIS $4.00.

From conference on the American Geophysical Union; San Francisco, California, USA (12 Dec 1974).

The relation between the plasmapause and the light ion trough offers a potential tie between the low and high altitude magnetosphere if the plasma distribution along the field lines between L equals 2 to 6 region can be measured. The data from several simultaneous satellite-ground based measurements of ion density and plasmapause position were measured. (JFP)

1743 (N-74-26274) MODEL OF THE TRAPPED ELECTRON POPULATION FOR SOLAR MINIMUM. Teague, M. J.; Vette, J. I. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1974. 140p. (NASA-TM-X-69909; NSSDC-74-03). NTIS $10.00.

A model is presented of the trapped electron environment of solar minimum conditions. Solar maximum models were presented for the inner radiation zone (AE-5 1967), and for the outer radiation zone (AE-4 1967). The present solar minimum model consists of an inner zone model (AE-5 1975 Projected) with an epoch of 1975, and an outer zone model with an epoch of 1964. With only minor modifications this latter model is identical to the AE-4 1964 model presented previously. The model, however, has not previously been issued in computer form. AE-4 1964 is based upon satellite data, while the inner zone solar minimum model AE-5 1975 Projected consists entirely of extrapolations from AE-5 1967. While the two components of the solar minimum model have epochs 11 years apart, it is assumed that any differences between the successive solar minima are smaller than the model error, and the complete model is associated with an epoch of 1975. (auth)

1744 ELECTRIC FIELD MEASUREMENTS NEAR THE SOUTHERN POLAR CUSP. Berthelier, J. J.; Delahaye, J. Y.; Gogly, G. (Centre National de la Recherche Scientifique, 94 - Saint-Maur-des-Fosses (France). Groupe de Recherches Ionospheriques); Mozer, F. S. (California Univ., Berkeley (USA). Space Sciences Lab.). SPARMO Bull.; 5: No. 4, 281-291(May 1974).

During the austral summer campaign 1972-1973, nine stratospheric balloons were launched from the French Antarctic Station Dumont d'Urville (140.0 deg E - 66.6 deg S) in order to measure the ionospheric electric field. These experiments were part of a program conducted by the Groupe de Recherches Ionospheriques to study the magnetospheric convection and some related ionospheric phenomena near the polar edge of the southern polar cusp. Measurements were made using a double probe electric field detector identical to that used by MOZER on numerous previous flights. In spite of rather poor meteorological conditions for launching, eight balloons were successfully flown and more than 250 hours of data acquired. A preliminary report on the experiment is given, and some initial results from a rapid analysis of the data are presented. (FR)

1745 A THEORY OF AURORAL HISS AND IMPLICATIONS ON THE ORIGIN OF AURORAL ELECTRONS. Swift, D.W.; Kan, J.R. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). J. Geophys. Res. 80: No. 7, 985-992 (1 Mar 1975).

A theory for auroral hiss is developed based on the existence of a beam of energetic particles that is also believed responsible for the visual aurora. A dispersion relation for electromagnetic waves in a plasma consisting of an electron beam and a background plasma is derived. The Hermitian part of the dispersion relation is assumed to be governed by the denser cold background plasma, whereas the anti-Hermitian part is governed by the electron beam. It is shown that the electron beam can excite an electron whistler mode instability near the resonance cone by the Landau interaction because near the resonance cone the phase velocity of the wave can be made arbitrarily small. The instability can be excited at all frequencies between the lower hybrid resonance and the electron plasma frequencies. The wave normal angles along the resonance curve vary between 0° and 90° with respect to the magnetic field. Waves whose wave normal angles are small have the largest growth rates and are most likely to grow to observable amplitudes. Only waves generated within a few degrees of the vertical can reach the ground. The results of the calculations are applied to auroral hiss observations. From the fact that auroral hiss is observed on the ground at frequencies less than 10 kHz it is concluded that at least some of the auroral hiss is generated at altitudes where the ambient electron density is of the order of 1 cm^{-3}. This suggests that auroral electrons are energized in regions where the ambient density is of the order of 1 cm^{-3} or less. (auth)

1746 ELECTRON TEMPERATURES IN THE WAKE OF AN IONOSPHERIC SATELLITE. Troy Jr., B.E.; Maier, E.J. (Goddard Space Flight Center, Greenbelt, Maryland 20771); Samir, U. J. Geophys. Res. 80: No. 7, 993-997 (1 Mar 1975).

We present measurements of electron temperature T_e made by a retarding potential analyzer and a Langmuir probe (both flush-mounted on the spin-stabilized satellite Explorer 31) to investigate the variation of T_e around the satellite. Most of the time there is a T_e variation, which repeats for given ionospheric conditions. The variations is strongly controlled by the angle between the velocity vector and the probe normal, T_e usually being enhanced in the near wake of the satellite. Magnetic field control of T_e, if it is present, is hidden by the stronger velocity vector control. Our results indicate that the magnitude of the T_e enhancement in the wake does not depend on the average ion mass M, although the electron density depletion in the wake is strongly correlated with M. (auth)

1747 A STUDY OF THE NIGHTTIME *D* REGION DURING A PCA EVENT. Swider, W.; Narcisi, R.S. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730). J. Geophys. Res. 80: No. 4, 655-664 (1 Feb 1975).

A simple model for the nighttime *D* region under disturbed conditions that treats negative ions as a group has been developed. Good quantitative agreement is obtained between the major positive ions of the model and nighttime data for a PCA event by Narcisi et al. (1972*a*). Atomic oxygen, water vapor, and nitric oxide concentrations necessary to fit the data deduced. The derived [O] and [H_2O] profiles are shown to be in harmony with theoretical predictions by others. The deduced [H_2O] mixing ratio is 1 part per million by volume within a factor of 3 accuracy, there being some indication that the ratio is declining with altitude above about 80 km. An upper limit for [NO] of about 100 parts per billion by volume is determined, and a rough estimate for [NO_2]/[NO] is given. The major three-body NO^+ loss process appears to be $NO^+ + CO_2 + N_2 \rightarrow NO^+ \cdot CO_2 + N_2$. It is pointed out that the reaction $O_4^+ + M \rightarrow O_2^+ + O_2 + M$ may be important, especially if mesospheric temperatures are higher than normal as a result of a man-made or natural disturbance. (auth)

1748 CLEFT SIGNATURE IN PROTON FLUXES ABOVE 100 keV. Amundsen, R.; Søraas, F.; Aarsnes, K. (Department of Physics, University of Bergen, Bergen, Norway). J. Geophys. Res. 80: No. 4, 685-689 (1 Feb 1975).

Experimental evidence is presented that the low-energy proton population, which is the signature of the polar cleft region, has a high-energy tail of above 100−keV proton fluxes. The precipitation zone of these higher-energy protons covers the same latitude band as the low-energy particles do and also experiences the same latitudinal displacements during changes in the geomagnetic conditions. The precipitation has an isotropic pitch angle distribution and the measured higher-energy intensities compare favorably with values extrapolated from the spectrum at lower energies. The statistical invariant latitude pattern described by above 100-keV precipitating protons in the magnetic local time span 0006–1800 hours is presented. (auth)

1749 IONOSPHERIC ELECTRON CONTENT AND EQUIVALENT SLAB THICKNESS IN THE EQUATORIAL REGION. Gupta, A.D.; Basu, S.; Bhar, J.N. (Institute of Radio Physics and Electronics, University of Calcutta, Calcutta 9, India); Bhattacharyya, J.C. J. Geophys. Res. 80: No. 4, 699-701 (1 Feb 1975).

The ionospheric total electron content and equivalent slab thickness in the equatorial region around 75°E have been studied. It is found that the slab thickness exhibits a strong latitudinal dependence with a maximum at the magnetic equator and a minimum around the crest of the F_2 anomaly, indicating that the F region is thick near the equator and most skewed near the crest. The results are consistent with the electrodynamic drift and diffusion in the equatorial ionosphere. (auth)

1750 AURORAL EMISSION OF THE N_2^+ MEINEL BANDS. Cartwright, D.C. (Chemistry and Physics Laboratory, Aerospace Corporation, El Segundo, California 90045); Pendleton, W.R. Jr.; Weaver, L.D. J. Geophys. Res. 80: No. 4, 651-654 (1 Feb 1975).

New cross sections for electron impact excitation and quenching of the N_2^+ Meinel bands have been combined with recently determined transmission probabilities to yield altitude profiles of the Meinel bands relative to those for the N_2^+ first-negative system. Quenching of the Meinel bands is found to compete with radiative decay for altitudes less than 120 km, and the quenching height (the altitude at which one half of the excited molecules are collisionally deactivated) is found to be approximately 85 km. The calculated intensity of the Meinel band system relative to that of the first-negative system agrees reasonably well with the more recent auroral measurements. (auth)

1751 INVESTIGATIONS OF THE IONOSPHERIC *F* REGION USING MULTISTATION TOTAL ELECTRON CONTENT OBSERVATIONS. Mendillo, M.; Klobuchar, J.A. (Ionospheric Physics Laboratory, Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730). J. Geophys. Res. 80: No. 4, 643-650 (1 Feb 1975).

A network of stations near the 70°W meridian has been used to monitor continuously the polarization of the VHF beacon signal from the geostationary satellite ATS 3. Measurements of the amount of Faraday rotation experienced by the signal in traversing the ionosphere permit continuous observations of the ionospheric total electron content (TEC) to be made over the invariant latitude range 34°-73°. When the TEC data are combined with ground-based ionosonde data from nearby locations, it is also possible to monitor the peak density (N_{max}) of the F_2 region and the equivalent slab thickness ($\tau = TEC/N_{max}$). Observations from six stations made in December 1971 were used to construct computer-generated contour maps of the TEC, N_{max}, and τ monthly median behavior on an invariant latitude (A) versus local time grid. Comparisons between daily TEC contours and the monthly median contours reveal dramatic effects induced by substorms (December 8-9) and major geomagnetic activity (December 17-18). (auth)

1752 A COMPARISON OF SATELLITE OBSERVATIONS OF BIRKELAND CURRENTS WITH GROUND OBSERVATIONS OF VISIBLE AURORA AND IONOSPHERIC CURRENTS. Armstrong, J.C. (Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland 20910); Akasofu, S.; Rostoker, G. J. Geophys. Res. 80: No. 4, 575-586 (1 Feb 1975).

Observations of Birkeland (field aligned) currents inferred from magnetic field perturbations observed at ~800-km altitude by the Triad satellite are correlated with simultaneous ground-based auroral and magnetic observations. A detailed study of one satellite pass is presented in which the ground-based data are used to locate the position of the substorm-disturbed region with respect to the region of the upper atmosphere through which Triad passed. Two other cases are presented to show the repeatable character of the correlation between the Triad data and the auroral arc configuration. It is found that the poleward discrete arc existing at the time of the pass marks the northernmost boundary of the Birkeland current region and all the visual auroral arcs lie within the latitudinal regime occupied by the Birkeland current flow. The dominant feature of the Birkeland current flow in the evening sector is intense upward flow just equatorward of the poleward arc. A broad region of diffuse inward flowing current flows in the region further equatorward. The eastward electrojet in the evening sector flows in the region bounded by the Birkeland current flow, and the poleward border of the electrojet coincides with the poleward edge of the upward field aligned current flow. (auth)

1753 AURORAL ELECTROJET CURRENT DENSITY DEDUCED FROM THE CHATANIKA RADAR AND FROM THE ALASKA MERIDIAN CHAIN OF MAGNETIC OBSERVATORIES. Kamide, Y. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701); Brekke, A. J. Geophys. Res. 80: No. 4, 587-594 (1 Feb 1975).

The use of the equivalent overhead current approximation for geomagnetic perturbations is critically examined by using the height-integrated ionospheric current density deduced by the Chatanika incoherent scatter radar and the simultaneous ground magnetic variations from the Alaska meridian. It is found that time variations of *H* on the earth's surface are in good agreement with those of the observed east-west ionospheric current density if variations in width and location of the electroject with respect to a ground-based observatory are carefully examined. However, by using the conventional infinite overhead current approximation the height-integrated current density in the ionosphere is, on the average, underestimated by a factor of 2 or more. (auth)

1754 THE OMEGA 2 CAMPAIGN. X-Ray Measurement at Subauroral Conjugate Points and Ground-Based Measurements of Ionospheric Perturbations. Treilhou, J. P. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). SPARMO Bull.; 5: No. 4, 313-331(May 1974). (In French).

The scientific aims of the OMEGA 2 campaign are presented: investigation of the mechanisms and location of the sources of electron precipitations during substorms, by the way of balloon X-ray and ground-based measurements at subauroral latitudes (L approximately 3.8) in conjugate areas. Concerning X-ray precipitation, the following aspects were desired to be investigated: slow variations, pulsations in the period range 1-50 seconds, microbursts, energy spectrum. After a brief description of the X-ray detectors used during the campaign, the main constraints encountered by the use of balloon techniques are reviewed. Indications are given of the geophysical conditions used to be in flight at the right time. Finally the list of the balloon flights is given together with the corresponding magnetic activity. (FR)

1755 HUYGEN'S PRINCIPLE USED ON VLF FIELD CALCULATIONS ON DISTANCES LESS THAN 1500 km. Bjoentegaard, G. (Norske Institut for Kosmisk Fysikk, Oslo). Geophys. Norv.; 30: No. 5, 13-30(1973).

In this work, a new method called "area integration" for calculating VLF phase and amplitude over distances less than 1500 km is developed. It is based on Huygen's principle and has similarities to the scattering theory, in that the ionosphere is subdivided into small elements and the reflected contributions from all elements are summed up to give the total wave field. Calculations using area integration are compared with wave-guide mode calculations. The fit is good between 600 and 1500 km. Calculations also agree well with the geometrical optics or ray theory model up to about 600 km, where this model breaks down due to the earth's curvature. Calculations are also made for a high latitude path in Northern Norway where recordings were made continuously on two frequencies. It is concluded that the deduced method is the best for propagation distances between 600 and 1500 km since it is more accurate than the geometrical optics model and cheaper in computing time than mode theory. Furthermore, the area integration method makes it possible to incorporate horizontal gradients in the electron density, which is impossible in the other models used for VLF propagation. (auth)

1756 IONOSPHERIC PLASMA INSTABILITIES AND ANOMALOUS ABSORPTION. Chen, S. C. San Diego, CA; Univ. of California (1974). 140p. University Microfilms Order No. 75-4633.

Thesis (Ph. D.).

Radio wave absorption caused by ionospheric irregularities is discussed. Saturation of the decay instability in the presence of a magnetic field is considered. (Diss. Abstr. Int., B)

Magnetospheric Phenomena

Refer also to abstracts 857, 1716, and 1742.

1757 RESPECTIVE ROLE OF THE COLD AND WARM PLASMA DENSITIES ON THE GENERATION MECHANISM OF ULF WAVES IN THE MAGNETOSPHERE. Perraut, S.; Roux, A. (CNET, Issy-les-Moulineaux, France). J. Atmos. Terrest. Phys.; 37: No. 3, 407-418(Mar 1975).

Amplification of ion cyclotron waves is studied for different values of the ratios between the cold and warm plasma densities and between the resonant and parallel thermal velocities. Growth rates are then optimized for any set of magnetospheric parameters. The role of the cold plasma density is examined. It is shown that there exists a preferential value of the cold plasma density which gives the largest maximum growth rate. An increase of the warm plasma density always leads to an increase of the maximum growth rate. The L-value for which particles of a given initial energy are more likely to be precipitated during their inward penetration is also investigated. The model chosen to represent the radial variation of the anisotropy is shown to be of vital importance. (auth)

1758 SUBSTORM-INJECTED PROTONS AND ELECTRONS AND THE INJECTION BOUNDARY MODEL. Konradi, A. (NASA Johnson Space Center, Houston, Texas 77058); Semar, C.L.; Fritz, T.A. J. Geophys. Res. 80: No. 4, 543-552 (1 Feb 1975).

Observations of substorm-associated enhancements of proton and electron fluxes were made by Explorer 45 below $L=5.3$ in the dusk magnetosphere on February 13, 1972. The particles were observed after a substorm that started at 1116±0010 UT in the wake of an ssc at 0939 and that initiated a small magnetic storm with maximum $Dst=47$ γ. The protons in the range between 1 and 40 keV exhibit strong dispersion effects in both energy and pitch angle. The electrons also show dispersion effects above 40 keV, while those below that energy are not observed until the satellite crosses the plasmapause. The observations are interpreted in terms of McIlwain's model electric field E3 and an injection boundary close to or coinciding with the plasmapause. Good quantitative agreement is obtained between the observed and the predicted proton energies and pitch angle dispersions and electron

energy dispersions. In view of strong temporal fluctuations in the electron flux, no comparison in pitch angle dispersion of electrons is possible. The conclusion drawn is that in this event protons and electons were injected at the onset of the substorm more or less instantaneously into the magnetosphere along or above the injection boundary and particles with energies below 10 keV were not convected in from the magnetospheric tail. (auth)

1759 DYNAMIC RELATIONSHIP BETWEEN PROTON AND ELECTRON AURORAL SUBSTORMS. Fukunishi, H. (Geophysical Institute, University of Tokyo, Tokyo, Japan). J. Geophys. Res. 80: No. 4, 553-574 (1 Feb 1975).

The simultaneous observations of the dynamic behavior of proton and electron auroras were carried out from March to October 1970 at Syowa station (corrected geomagnetic latitude, −66.7°; longitude, 72.5°) in Antarctica. The hydrogen Balmer beta (Hβ) was selected as a typical emission line from proton auroras, whereas N_2^+ 4278−Å, and O I 5577−Å, and O I 6300−Å emissions were selected for electron auroras. The Hβ photometer has a tilting filter to measure rapid space-time variations of faint proton auroras free from the contamination of strong electron auroras, whereas the other photometers have fixed interference filters. By means of the records of these meridian-scanning photometers the developing features of the proton and electron auroral substorms are investigated in detail. It is found that during the period preceding the onset of a substorm expansion phase the emission zone of the proton aurora moves equatorward with a speed of 100–250 m/s, accompanying the development of the ring current. It is also found that at the onset of the expansion phase the quiet arcs suddenly brighten generally in the premidnight region and the electron auroral bulge rapidly expands poleward and westward. In the postmidnight region it is observed that the emission zone of proton auroras rapidly expands poleward with a large increase in luminosity. Proton auroras are absent in the leading edge of the expanding electron auroral bulge, whereas breakup-type electron auroras (arcs of bands) are not observed in the expanding proton auroral bulge. Therefore it is suggested that there is a mechanism that accelerates electrons in the premidnight region and protons in the postmidnight region along the geomagnetic field lines down to the ionosphere. After the onset of the expansion phase the luminosity of the proton aurora greatly increases in the evening region, and simultaneously, the emission zone expands equatorward, accompanying the development of the asymmetric partial ring current and the positive bay in this local time region. This relation indicates that the source of the proton aurora in the evening region is the injected ring current protons. (auth)

1760 THE MOTION OF A PROTON IN THE EQUATORIAL MAGNETOSPHERE. Stern, D.P. (Theoretical Studies Group, Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 4, 595-599 (1 Feb 1975).

In a time-independent model of the magnetosphere including a dipole magnetic field, a convection electric field (deduced from polar orbit observations), and an electric field due to the earth's rotation the motion of a proton in the equatorial plane is analyzed. By means of the Hamiltonian W of the motion, three regimes of motion are identified. A method is then developed for determining for any given observation point which arrival energies correspond to trapped particles and which represent 'open' trajectories. (auth)

1761 INTERACTION BETWEEN HEAVIER IONS AND RING CURRENT PROTONS. Brice, N.; Lucas, C. (School of Electrical Engineering, Cornell University, Ithaca, New York 14853). J. Geophys. Res. 80: No. 7, 936-942 (1 Mar 1975).

The interaction of thermal oxygen or helium ions and ring current protons may produce a wide variety of phenomena in the magnetosphere. These include the production of energetic oxygen ions or energetic helium ions, modification of the bulge region in the afternoon plasmasphere, heating of electrons in the upper ionosphere and production of stable auroral red arcs, precipitation of energetic protons, and precipitation of energetic α particles. Large-amplitude waves generated in the interaction may also lead to wave-wave coupling. The theory developed also suggests that heavier ions such as lithium artifically injected into the ring current to remove ring current protons may be heated substantially in the process. Computations of wave growth have been made for the first time by using measured ring current fluxes and anisotropies. (auth)

1762 THE QUIET TIME STRUCTURE OF ENERGETIC (35–560 keV) RADIATION BELT ELECTRONS. Lyons, L.R.; Williams, D.J. (Space Environment Laboratory, NOAA/ERL, Boulder, Colorado 80302). J. Geophys. Res. 80: No. 7, 943-950 (1 Mar 1975).

Detailed Explorer 45 equatorial observations of the quiet time structure of radiation belt electrons (35–560 keV) for $1.7 \lesssim L \lesssim 5.2$ are presented. Throughout the slot region and outer regions of the plasmasphere the observed pitch angle distributions are found to agree with those expected from resonant interactions with the plasmaspheric whistler mode wave band. Coulomb collisions become the dominant loss mechanism within the inner zone. The overall two-zone structure of the observed radial profiles is found to agree with the equilibrium structure expected to result from a balance between pitch angle scattering losses and radial diffusion from an average outer zone source. This agreement suggests that the dominant quiet time source and loss mechanisms have been identified and evaluated for energetic radiation belt electrons within the plasmasphere. In the outer regions of the plasmasphere ($L \sim 5$) the equilibrium structure is observed to be modified by daily flux variations associated with changes in the level of magnetic activity that occur even during relatively quiet times. Within the inner region of the plasmasphere ($L \lesssim 3.5$), electron fluxes are decoupled from these magnetic activity variations by the long time scales (>10 days) required for pitch angle and radial diffusion. Consequently, fluxes of these electrons are observed to remain nearly constant at equilibrium levels throughout the quiet periods examined. (auth)

1763 THE L=6.6 OOSIK BARIUM PLASMA INJECTION EXPERIMENT AND MAGNETIC STORM OF MARCH 7, 1972. Wescott, E.M.; Stenbaek-Nielsen, H.C.; Davis, T.N.; Murcray, W.B. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701); Peek, H.M.; Bottoms, P.J. J. Geophys. Res. 80: No. 7, 951-967 (1 Mar 1975).

The high-altitude detonation of a high-explosive shaped charge vaporizes a hollow conical liner of barium metal and produces a fast field-aligned jet of plasma with approximately 1 mol of ions having initial velocities distributed from 8 to 20 km/s. Such a barium plasma injection experiment was performed at 540-km altitude over Alaska (L=6.6) in dusk of March 7, 1972 (universal time), in an attempt to trace out and observe the dynamics of an auroral field line in the magnetosphere. With image orthicon TV systems and image intensified cameras the resulting streak rising into the magnetosphere was observed for 30 min and out to 3−R_E altitude. A 1.5−m-aperture photometer detected the barium streak at R (release) +35 min at nominal look angles where the ions would be near altitudes of 5 and 2R_E from the magnetic equator. The injection occurred during a quiescent phase of a magnetic storm initiated by an ssc 10 hours prior to the experiment. Quiet auroral arcs existed over Alaska at locations more than 200 km south of the injection point. The barium flux tube drifted first eastward and then southward owing to an electric field E, with $E \times B/B^2$ velocities of several hundred meters per second, while also splitting into at least seven seperate flux tubes distributed along 200 km parallel to L. At R+16 min an intense auroral activation and magnetic substorm (the Oosik substorm) began in the Alaskan sector. Subsequent poleward expansion of the aurora and formation of a classic spiral resulted in the intersection and crossing of the barium flux tubes by an auroral arc. Very rapid, almost turbulent, motions of the barium flux observed during the intersection interval resulted from local transient E fields of 200 mV/m directed inward toward the auroral arc. Observations of the distortion of the barium flux tubes on opposite sides of the aurora as compared with a field model including the superdisturbed external coefficients of Mead and Fairfield (1973) offer evidence for an upward Birkeland current sheet at the poleward edge of the auroral spiral of 8×10^{-2} A/m. The Oosik substorms was spatially limited to dusk sector; it occurred during the decaying phase of a larger substorm observed in the midnight to dawn sector. The substorm and aurora had several unusual features. Examination of the question as to wheather the plasma injection may have triggered the substorm unveiled no compelling evidence that it did; however, the unusual features of the substorm leave open that possibility. (auth)

1764 DYNAMICS OF MID-LATITUDE LIGHT ION TROUGH AND PLASMA TAILS. Chen, A.J.; Grebowsky, J.M.; Taylor, H.A. Jr. (Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 7, 968-976 (1 Mar 1975).

Light ion trough measurements near midnight made by the Bennett RF ion mass spectrometer on Ogo 4 operating in the high-resolution mode reveal the existence of irregular structure on the low-latitude side of the mid-latitude trough. By using two different relations between the equatorial convection electric field, assumed to be spatially invariant and directed from dawn to dusk, and Kp (one based on plasmapause measurements and the other on polar cap E field measurements) a model development was made of the outer plasmasphere. The model calculations produced multiple plasma tails that compare favorably with the observed thermal proton irregularities. Owing to magnetic local time differences between the northern amd southern hemisphere protons of the Ogo orbit, the time dependent irregularity structure observed is not symmetrical about the equator. The model development produces an outer plasmasphere boundary location that varies similarly to the observed miniumum density point of the light ion trough. However, the measurements are not extensive enough to yield conclusive proof that one of the electric field models is better than the other. (auth)

1765 ISOLATED COLD PLASMA REGIONS: OBSERVATIONS AND THEIR RELATION TO POSSIBLE PRODUCTION MECHANISMS. Maynard, N.C.; Chen, A.J. (Laboratory for Planetary Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 7, 1009-1013 (1 Mar 1975).

Regions of enhanced cold plasma, isolated from the main plasmasphere along the Explorer 45 (S^3-A) orbit in the equatorial plane, have been detected by using the sheath-induced potentials seen by the electric field experiment. The occurrence of these regions has a strong correlation with negative enhancements of *Dst*, and their locations are primarily in the noon-dusk quadrant. The data support the concpet that changes in large-scale convection play a dominant role in the formation of these regions. Plasma tails that are predicted from enhancements of large-scale convection electric fields in general define where these regions may be found. More localized processes are necessary to account for the exact configuration and structure seen in these regions and may eventually result in detachment from the main plasmasphere. (auth)

1766 LATITUDE AND LONGITUDE DEPENDENCE OF STORM TIME Pc 5 TYPE PLASMA WAVE. Lanzerotti, L.J.; Maclennan, C.G.; Fukunishi, H. (Bell Laboratories, Murray Hill, New Jersey 07974); Walker, J.K.; Williams, D.J. J. Geophys. Res. 80: No. 7, 1014-1018 (1 Mar 1975).

The recent study of a storm time Pc 5 plasma wave event by Lanzerotti, Fukunishi, Lin, and Cahill is extended by the analysis of recently available high-latitude ground-based magnetometer data and hot plasma particle ($\sim 1-40$ keV) distribution data from a satellite in the magnetosphere. These additional data suggest that an odd mode shear Alfvén wave (period ~ 7 min) was excited by a high β drift instability at a high-altitude gradient region of the hot plasma distribution. The region of occurrence of the instability was characterized by a cold plasma density of ~ 100 cm^{-3}. (auth)

1767 HIGH β PLASMA INSTABILITIES AND STORM TIME GEOMAGNETIC PULSATIONS. Lanzerotti, L.J.; Hasegawa, A. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Geophys. Res. 80: No. 7, 1019-1022 (1 Mar 1975).

Plasma and magnetic field data published for the December 16–18, 1971, magnetic storm period indicate that excitation of the mirror instability or the compressional drift wave instability may have been causes of long-period magnetic pulsation activity during portions of the storm. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Refer also to abstract 276.

Beams and Their Reactions

Refer also to abstract 332.

1768 CHARGE AND CURRENT NEUTRALIZATION PHENOMENA IN LOW-IMPEDANCE DIODE STRUCTURES. Genuario, R.; Bromborsky, A. (Harry Diamond Labs., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 253-258(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

An experiment to examine low energy electron beam transport (beta approximately 0.33) in a low impedance (one ohm) diode structure is described. Both charge and current neutralization as a function of pressure from 1 mTorr to 2 Torr were determined for the first time with an electron beam facility modified to permit rise times of 2 ns and pulse widths of 5 ns with a peak intensity of 25 A/cm^2. The results of the experiment indicate that for electron beams with this short time duration, charge neutralization will occur for pressures in the range 200–300 mTorr. Furthermore, Langmuir oscillations were observed in the 200 to 300 mTorr pressure regime and late-time plasma "tails", explained in terms of the magnetic diffusion time, were observed for pressures greater than or equal to 400 mTorr. Current neutralization of the beam was observed at 900 mTorr. Qualitative agreement is obtained between theory and experiment. (auth)

1769 COMPARISONS OF QUASI-STATIC AND FULLY DYNAMIC SOLUTIONS FOR ELECTROMAGNETIC FIELD CALCULATIONS IN A CYLINDRICAL CAVITY. Wenaas, E. P.; Woods, A. J. (Intelcom Rad Tech, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 259-263(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A fully dynamic, self-consistent computer code was developed to solve internal electromagnetic pulse (IEMP) problems in cylindrical geometries excited by a pulse of ionizing radiation. Comparisons between the fully dynamic and previous quasi-static solutions are made, and the range of validity of the quasi-static approximation is defined. Results show that nonlinear effects arising from field-perturbed electron motion significantly affect the range of validity of the quasi-static approximation. (auth)

1770 CHARACTERISTICS OF A POSITIVE HF ION-SOURCE IMMERSED IN AN AUXILIARY MAGNETIC FIELD. Gessinn, G. (Toulouse-3 Univ., 31 (France). Lab. de Physique Electronique et Ionique). Ind. At. Spatiales; 18: No. 4, 8-18(Jul 1974). (In French, English).

The influence of a longitudinal or transversal magnetic field on the operation of an HF source using argon is studied. In both cases, the positive ion current collected on a target after focusing has two peaks corresponding to specific values of the magnetic field. With the transversal magnetic field, higher luminance values of the source's cross-over image can be obtained than either with or without a longitudinal magnetic field. (FR)

1771 IMPROVEMENTS IN ATOMIC CLOCKS OR FREQUENCY STANDARDS USING A JET OF ATOMS, IN PARTICULAR ALKALINE ATOMS. Kastler, A.; Arditi, M.; Cerez, P. (to Agence Nationale de Valorisation de la Recherche (ANVAR)). French Patent 2,206,539/E/. 10 Nov 1972. 11p. (In French).

The clock comprises an oven adapted to generate a jet of Rb^{85} and Rb^{87}, a Rb^{85}-lamp, a microwave cavity, the light beam of said lamp passing through the jet upstream of the cavity so as to enrich the F = 1 energy level of the fundamental state of the Rb^{87} atoms, and downstream in order to provide a new enrichment after equalization of the populations of levels F = 1 and F = 2, and a detector (or sensor) completed by an electronic system for coupling a quartz-oscillator at atomic resonance. This arrangement can be used as frequency standard. (FR)

1772 OBSERVATION OF AN ANISOTROPIC EXCITATION OF THE ELECTRONS EMITTED BY A MONOCRYSTALLINE TARGET UNDER FAST ION IMPACT. Mischler, J.; Benazeth-Colombie, N. (Toulouse-3 Univ., 31 (France). Lab. de Physique des Solides). Compt. Rend., Ser. A, B; 278: No. 20, 897-900 (13 May 1974). (In French).

The angular distribution of secondary electrons emitted by copper monocrystals displays, when the incident ion velocity is greater than 5×10^5 m/s, not only maxima due to diffraction of the electrons during their transport but also new peaks which will be assigned to anisotropic excitation of the electrons during purely electronic collisions. (FR)

Atomic and Molecular Properties

Refer also to abstracts 1815 and 1892.

1773 (AED-CONF-74-306-005) A NEW VALUE OF THE FINE STRUCTURE CONSTANT FROM HELIUM FINE STRUCTURE. Lewis, M. L. (Yale Univ., New Haven, Conn. (USA). Gibbs Lab.). 1974. 14p. INIS.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

The fine structure splittings of helium atoms in the 2^3P state were measured by an atomic beam optical microwave method to an accuracy of 2 ppm. These are the most precise measurements of the fine structure available. From these measurements a value $\alpha^{-1} = 137.03598$ (2.0 ppm) for the fine structure constant was determined. (GE)

1774 RADIUS OF THE COULOMB HOLE. Boyd, R. J. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 53: No. 6, 592-597(15 Mar 1975).

The radius of the Coulomb hole in an atom or molecule is discussed in general terms and illustrated in detail for the ground state of the helium isoelectronic sequence. The calculations demonstrate a general tendency for the radius of the Coulomb hole to increase as a function of the distance of the reference electron from the nucleus and the existence of a nonzero lower limit (0.800 a.u. in He and 0.111 a.u. in Mg^{10+}) for the radius of the Coulomb hole. This limit is slightly larger than the radial distance at which the radial density distribution reaches its maximum. By expressing the correlation energy of an atom in terms of certain one and two electron expectation values, the relation between the correlation energy and the size and shape of the Coulomb hole is discussed. Detailed comparisons for the ground and 2^3S states of He are used to demonstrate the relation. (auth)

1775 RIGOROUS APPLICATION OF THE COLLECTIVE MODEL TO SOME RARE EARTH NUCLEI. Hird, B.; Huang, K. H. (Univ. of Ottawa). Can. J. Phys.; 53: No. 6, 559-573 (15 Mar 1975).

The collective model of an odd neutron in an axially symmetric deformed Woods–Saxon potential, coupled to a rotating core, and containing the full RPC and pairing corrections used to predict the full low lying rotational band spectrum of the nuclei with N = 91 to 97. Only three adjustable parameters were used in each nucleus to fit the complete spectrum. It was possible in several nuclei to obtain the correct level sequence and in most to confirm level assignments, and the adjusted parameters were in good agreement with accepted values. However, the accuracy of this method is insufficient, in most nuclei, to provide reliable predictions for as yet unidentified bands. The lack of good overall agreements in the low lying spectra of these nuclei confirms that the core shape parameters do change from one band to another. (auth)

1776 IN-BEAM ATOMIC SPECTROSCOPY. Martinson, I. (Research Inst. for Physics, Stockholm). pp 467-512 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Experimental methods used for in-beam atomic spectroscopy are surveyed with the discussion limited to investigations of free atoms and ions. A few specific examples of information about atomic energy levels, atomic lifetimes, and transition probabilities obtained by in-beam methods are given. Lifetime measurements having astrophysical consequences are examined. Atomic fine structure including Stark mixing in weak fields and Lamb shift measurements are discussed. Foil excitation mechanisms are mentioned briefly. (20 figures, 1 table, 154 references) (SDF)

1777 HINDERED ASYMMETRIC TOP WAVEFUNCTIONS FOR THREE-DIMENSIONAL $H+H_2$. Harms, S.H.; Wyatt, R.E. (Department of Chemistry, The University of Texas at Austin, Austin, Texas 78712). J. Chem. Phys. 62: No. 8, 3173-3180 (15 Apr 1975).

The perturbation technique for generating hindered asymmetric top rotor states for atom–diatom reactions described previously is applied to the $H+H_2$ exchange reaction. The external rotation of the H_3 system is that of an unhindered, nonrigid asymmetric top. Internal rotation (bending) of the system is described by hindered rotor functions of the internal angle. The method consists first of diagonalization of the energy

matrix in the hindered symmetric top representation. The bending potential is modeled from the Porter–Karplus surface for H_3. A limited number of the eigenfunctions obtained are then used as a basis for forming a matrix representation of the Coriolis–asymmetry coupling operators. A selection rule is derived which aids in the choice of hindered symmetric top basis states. The asymmetric top hindered rotor functions obtained are linear combinations of the unperturbed functions. Symmetry features of the hindered rotor functions are discussed. Numerical results are presented in the form of energy correlation diagrams and wavefunction plots. (auth)

1778 A STUDY OF A LOWER BOUNDING FORMULA FOR THE OVERLAP BETWEEN THE EXACT AND AN APPROXIMATE WAVEFUNCTION. Merkel, R.R. (Department of Chemistry and Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 62: No. 8, 3198-3203 (15 Apr 1975).

Weinhold's lower bounding formula for the overlap between the exact wavefunction and an approximate wavefunction is applied to the hydrogen atom. The lower bound is examined as a function of both the number of basis set terms used in the bounding inequality and the nonlinear variational parameter in this basis set. A method is then proposed and tested for approximating the integrals over H^2 and H^3 required by Weinhold's technique as products of integrals involving only H. In the case studied, the resulting approximate overlap bounds converged to the true bound. (auth)

1779 BOUND-STATE EXPANSION METHOD FOR CALCULATING RESONANCE AND NONRESONANCE CONTRIBUTIONS TO CONTINUUM PROCESSES: THEORETICAL DEVELOPMENT AND APPLICATION TO THE PHOTOIONIZATION OF HELIUM AND THE HYDROGEN NEGATIVE ION. Doyle, H.; Oppenheimer, M.; Dalgarno, A. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Phys. Rev. A 11: No. 3, 909-915 (Mar 1975).

A unified method for calculating both resonance and continuum contributions to photoionization cross sections by bound-state techniques is developed. The stationary scattering wave function for the atomic system is expanded in a subspace of discrete functions which is large enough to be nearly complete for the region near the nucleus involved in the photoionization process. Some of the functions in the subspace are selected by root-stabilization techniques to be accurate representations of the resonances while others represent continuum functions. The expression for the cross section is derived from the Fano treatment of autoionizing states. The accuracy of the method is demonstrated by the calculation of cross sections for photoionization of the ground state $1\,^1S$ of the hydrogen negative ion and the helium atom, and for the metastable $2\,^1S$ state of helium at energies in the continuum and through the resonance $2\,^1S$- $(2s2p)\ ^1P$ transition. (auth)

1780 LOWEST ENERGY LEVELS OF H^-, He, AND Li^+ IN INTENSE MAGNETIC FIELDS. Mueller, R.O. (Department of Physics, Yale University, New Haven, Connecticut 06520); Rau, A.R.P.; Spruch, L. Phys. Rev. A 11: No. 3, 789-795 (Mar 1975).

We present rough variational upper-bound estimates of some low-lying bound-state energy levels of two-electron systems, including H^-, He, and Li^+, in magnetic fields B above 10^{10} G, a regime that is relevant to recent astrophysical studies of pulsars. The simple trial wave functions that we use in the Rayleigh-Ritz calculations consist of single antisymmetrized products of single-particle orbitals which are predominantly *magnetic* in their spatial character. Most importantly, our results indicate that in the regime $10^{10} \lesssim B \lesssim 10^{13}$ G the H^- ion has at least one singlet and one triplet bound state; at 2×10^{12} G, e.g., the ionization energy of the triplet ground state of H^- is greater than 12 eV. (The number of bound states of H^- in this regime of B may be much greater; moreover, the number of levels and their depths is expected to increase monotonically with B.) These results appear to contradict a recent indication that there might not be any bound states of H^- above 10^{10} G. For $B \to \infty$ we also present the approximate leading asymptotic terms for the total (nonrelativistic) energies and corresponding ionization energies of some low-lying states of two-electron systems with nuclear charge $Z \geq 2$. (auth)

1781 VAN DER WAALS INTERACTION AND ITS EFFECTS ON THE HYPERFINE PRESSURE SHIFT IN THE SYSTEM $He_2(^3\Sigma^+)$. Das, G. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois). Phys. Rev. A 11: No. 3, 732-735 (Mar 1975).

Long-range interaction studies of the system $He_2(^3\Sigma^+)$ based on the multiconfiguration self-consistent-field formalism are reported. In this formalism the long-range contribution to the hyperfine pressure shift of metastable $He(2\,^3S)$ in buffer gas of ground-state He is discussed. It is found by actual computation to be an order of magnitude smaller than that predicted by the many-body perturbation theoretic approach. Possible explanations of the discrepancy are discussed. (auth)

1782 SINGLET-TRIPLET ANTICROSSINGS IN He. II. THE n = 6,7,8 $^{1,3}D$ STATES. Miller, T.A.; Freund, R.S.; Zegarski, B.R. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. A 11: No. 3, 753-757 (Mar 1975).

The method of singlet-triplet level anticrossing has been extended to the $n = 6\ ^{1,3}D$ levels of He. Measurement of this anticrossing gives a highly accurate determination of the zero-field singlet-triplet separation and a less accurate determination of the antisymmetric part of the spin-orbit coupling perturbation between the $n = 6\ ^{1,3}D$ states. The zero-field separation for $n = 6$, although considerably more accurate, is in essential agreement with previous optical results, confirming the accuracy of the intercombination line measurements. The singlet-triplet intervals calculated by many-body perturbation theory are also found to be in very good agreement with the experimental results. (auth)

1783 SUMMATION OF FEYNMAN ATOMIC DIAGRAMS WITH SIMPLE DENOMINATORS. 2: AUTOIONIZATION STATE OF THE He ATOM. Ivanov, L.N. Opt. Spectrosc. (USSR) 37: No. 5, 479-481 (Nov 1974).

The positions and widths of the $2s^2\ ^1S$ and $^2p^2\ ^1S$ autoionization states of the atom cannot be found by solving a complex secular equation. The matrix elements of a secular operator are calculated as the sum of contributions of certain Feynman diagrams from an entire series of perturbation theory. The contributions of the individual diagrams are compiled by means of a standard technique developed for degenerate stationary states. The basic system of integrodifferential equations is reduced to a system of linear algebraic equations. (auth)

1784 PARAMETRIC STUDY OF THE LOW-LYING ODD CONFIGURATIONS IN THE SPECTRA OF NEUTRAL AND SINGLY IONIZED URANIUM (UI AND UII). Guyon, F.; Blaise, J.; Wyart, J. F. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. Aime Cotton). J. Phys. (Paris); 35: No. 12, 929-933(Dec 1974). (In French).

By the use of new observations in the infrared (Fourier Transform Spectroscopy), the analysis of the first spectrum of uranium (UI) was extended. The lowest even levels belong to $5f^4\ 7s^2\ ^5I$ and new odd levels has been located. In order to facilitate their interpretation, the configuration $5f^36d\ 7s^2$ and the subconfiguration $5f^3(^4I)6d^2\ 7s$ have been calculated taking account of their interaction, following the methods of Racah. Sixty-eight levels are interpreted with a rms deviation of $124cm^{-1}$ in their energies. Results of a similar calculation for the configuration $5f^3\ 6d\ 7s$ in UII are also discussed. (FR)

1785 I. PARITY VIOLATION INDUCED BY WEAK NEUTRAL CURRENTS IN ATOMIC PHYSICS. Bouchiat, M. A. (Ecole Normale Superieure, 75 - Paris (France). Lab. de Spectroscopie Hertzienne); Bouchiat, C. (Centre National de la Recherche Scientifique, 75 - Paris (France)). J. Phys. (Paris); 35: No. 12, 899-927(Dec 1974).

A general analysis of the parity violating phenomena induced by neutral currents in Atomic Physics is presented. Expressions for the short range parity violating electron-nucleus and electron-electron potentials predicted by the theoretical schemes of weak interactions featuring neutral currents were given. A detailed computation of the matrix element, between one-particle s and p states, of the electron-nucleus parity violating potential is given. Using a non-trivial extension of a method used by Foldy to put on a more rigorous basis a formula of Fermi and Segre giving the wave function of an s valence electron at the nucleus, a remarkably simple expression, in terms of the binding energies, with a small correcting term involving the interpolated quantum defect and the potential of the electronic cloud at the origin is obtained. Arguments are given which lead to the belief that the accuracy of the formula is comparable to that of the Fermi-Segre formula, i.e., a few % when $Z \gg 1$. Besides its simplicity, a remarkable feature of the results is a Z^3 dependence which obviously favors heavy atoms. A brief analysis of the manifestation of parity mixing in atomic radiative transitions, with a particular emphasis on the implications of time reversal invariance, which is preserved by the interactions discussed. In order to improve the existing limits, we suggest looking for parity violating effects in twice forbidden magnetic dipole transitions induced by a tunable laser beam in heavy atoms. In a typical case, like the $6S_{\frac{1}{2}} - 7S_{\frac{1}{2}}$ transition in atomic Cesium, a circular dichroism of the order of 10^{-4} is predicted. Finally we discuss the apparently more remote possibilities offered by the muonic atoms. (FR)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 1848.

1786 (AED-CONF-74-306-001) PRELIMINARY EXPERIMENTAL RESULTS ON THE ENERGY DIFFERENCE BETWEEN

THE $2S_{\frac{1}{2}}$ AND $2P_{\frac{1}{2}}$ LEVELS OF THE $(\mu^4He)^+$ SYSTEM. Bertin, A.; Carboni, G.; Placci, A.; Zavattini, E.; Duclos, J.; Picard, J.; Gastaldi, U.; Gorini, G.; Neri, G.; Pitzurra, O. (European Organization for Nuclear Research, Geneva (Switzerland)). 1974. 22p. INIS.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

Since 1972 an experimental set-up was built, and successively used at CERN, in order to perform a precise measurement of the energy difference S_1 between the $2S_{\frac{1}{2}}$ and $2P_{\frac{1}{2}}$ levels of the helium muonic ion $(\mu^4He)^+$. The present status of the experiment giving a preliminary result of (8,120 ± 7)A for S_1 in wavelength units is reported. (GE)

1787 (AED-CONF-74-306-002) INTERACTION OF LOW ENERGY POSITRONS WITH GASEOUS ATOMS AND MOLECULES. Coleman, P. G.; Griffith, T. C.; Heyland, G. R.; Killeen, T. L. 1974. 16p. INIS.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

Available from ZAED.

The study of positron interactions with atoms and molecules made during the last two years is reviewed. Reliable measurements of the total cross sections for positrons of controllable energy in the range of 2-400 eV in various gases are now available and these can be compared with some recent theoretical calculations especially in the case of helium. Below 2 eV improvements in the technique of measuring positron lifetime spectra are yielding new information on the behavior of thermalized positrons in various gases and gaseous mixtures at different pressures. (GE)

1788 (AED-CONF-74-306-004) THE VACUUM POLARIZATION CORRECTION IN MUONIC ATOMS. Engfer, R.; Vuilleumier, J. L.; Borie, E. 1974. 11p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

2 figs.; 4 tabs.; 41 refs. Published in the proceedings.

In muonic atoms the vacuum polarization turns out to be the major contribution to the radiative corrections. Because two previous experiments for measuring higher transitions in muonic atoms showed a rather large discrepancy, an independent measurement with a new calibration technique was performed at CERN. The final analysis of these measurements and the present status of the vacuum polarization correction combining all experiments and known theoretical calculations are reported. (GE)

1789 (LBL-3817) POSITIVE MUON STUDIES OF MAGNETIC MATERIALS. Patterson, B. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 28 Mar 1975. Contract W-7405-ENG-48. 109p. Dep. NTIS $8.50.

Polarized positive muons (mu^+) are stopped in magnetic materials, and the mu^+ precession is observed via the muon's asymmetric decay to a positron. The precession frequency is a measure of the local magnetic field at the mu^+. Relaxation of the mu^+ spin is caused by spatially or time-varying local fields. The local field at a stopped mu^+ in ferromagnetic nickel is measured. From this measurement, the hyperfine field seen by an interstitial mu^+ due to its contact interaction with polarized screening electrons is inferred to be -0.66kG. A discussion of this value in terms of a simple model for the screening configuration is presented. Critical spin fluctuations in Ni at temperatures just above the Curie point rapidly relax the mu^+ spin. The temperature and external magnetic field dependence of the relaxation rate is determined experimentally. A theory for the relaxation rate is presented which demonstrates the importance of the hyperfine and dipolar interactions of the mu^+ with its Ni host. Preliminary results on mu^+ studies in ferromagnetic iron and cobalt are also discussed. (auth)

1790 SELFCONSISTENT MANY-PARTICLE EQUATIONS FOR ELECTRONS AND MUONS AND THEIR EFFECTS ON MUONIC ATOMS. Rafelski, J. Frankfurt am Main; Univ. Frankfurt (1973). 42p. (In German). INIS.

Thesis.

From the general Langragian for electrons, muons and photons a set of coupled single-particle self-consistent equations are derived. The self-consistent terms contain vacuum polarization and self-energy terms and the mutual interaction between electrons and muons. Iterating this interaction it is shown that the Uehling term of vacuum polarization should be calculated with screened electronic wave functions. It is shown that this effect cancels the observed discrepancy between theory and experiment in muonic atoms. (GE)

1791 PRESSURE DEPENDENCE OF POSITRON ANNIHILATION IN ALKALI METALS. Kubica, P.; Scott, M. J. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 53: No. 5, 450-454(1 Mar 1975).

The observed pressure dependence of the total positron annihilation rates in alkali metals was studied. The observation that the rates increase more rapidly with pressure than the estimated valence annihilation rates alone was explained in terms of increased positron penetration into the ion cores. This picture is shown to be consistent with observed changes with pressure in angular correlation data for Na. (auth)

1792 CHARGE-DISTRIBUTION PARAMETERS, ISOTOPE SHIFTS, ISOMER SHIFTS, AND MAGNETIC HYPERFINE CONSTANTS FROM MUONIC ATOMS. Engfer, R.; Schneuwly, H.; Vuilleumier, J. L.; Walter, H. K.; Zehnder, A. (CERN, Geneva). At. Data Nucl. Data Tables; 14: No. 5-6, 509-597(1974).

A compilation of muonic-atom data providing information on the size of nuclei is presented: energies of mu x-ray transitions, theoretical corrections, isotope and isomer shifts, and magnetic hf constants. Besides root-mean-square radii, equivalent radii from a model-independent analysis are given. (auth)

1793 TABLES OF ELECTRON SCREENING AND HIGHER-ORDER VACUUM POLARIZATION POTENTIALS IN MESIC ATOMS. Vogel, P. (California Inst. of Tech., Pasadena). At. Data Nucl. Data Tables; 14: No. 5-6, 599-604(1974).

The electron screening potential, applicable to the screening correction calculation in exotic atoms, is tabulated. The potential is calculated for atomic numbers Z equals 35–90 (with steps DELTA Z equals 5) and for radial distances from zero to the radius of the electron K-orbit. An empirical, three-parameter formula for the screening potential is suggested and its coefficients calculated. The radial dependence of the e^+e^- vacuum polarization potentials of the order $(\text{alpha})^2$(Z alpha) and $(\text{alpha})^3$ is calculated and tabulated for radii 0.1–1.0 Dirac constant/m/sub e/c. (auth)

1794 OPTICAL POTENTIAL CALCULATIONS FOR THE 1 s LEVEL IN PIONIC ATOMS. Tauscher, L. (European Organization for Nuclear Research, Geneva (Switzerland), Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik, Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Schneider, W. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 271: No. 4, 409-415(Dec 1974).

The Ericson-Ericson optical potential for the π-nucleus s-wave interaction was extended to be applicable also to light nuclei. In particular, terms of order A^{-1} were evaluated and the (π2N) dispersion was considered. From comparison with experimental data it was found that considerable improvement could be achieved by introducing terms of order A^{-1}. The (π2N) dispersion was found to be repulsive and of the same magnitude as the absorption. The (πN) scattering lengths were deduced to be $\alpha_3 - \alpha_1 = 0.258 \pm 0.008\ m_\pi^{-1}$ and $\alpha_1 + 2\alpha_3 = -0.018 \pm 0.008\ m_\pi^{-1}$. (auth)

Collision Phenomena

Refer also to abstract 1777.

1795 (AED-CONF-74-306-010) COLLISION STUDIES WITH ION STORAGE TECHNIQUES. Dunn, G. H. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). 1974. 13p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

A progress report is given on recombination measurements made by studying electron-ion collisions in ion traps, beginning with a brief review on two-body recombination processes between electrons and ions and the means by which they have previously been measured. Then the trapping scheme and its realization for collision work is discussed, and finally the results for some recombination measurements are given. (GE)

1796 (JUL-1091-FF) TWO-STATE APPROXIMATION FOR INELASTIC ATOMIC COLLISIONS WITHIN THE FRAMEWORK OF AN EXACTLY SOLUBLE MODEL. Dettmann, K.; Drepper, F.; Steinbeck, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Jul 1974. 47p. (In German). INIS.

Within the impact parameter treatment for inelastic atomic collisions the accuracy of the two-state approximations with atomic and molecular orbitals is estimated by comparison with an exactly soluble linear model. In this model with two delta-function-potentials of equal strength, suggested by G. Breit, the transition probabilities for elastic collisions and for charge exchange are solved exactly. These solutions show characteristic oscillations with varying impact velocity as have been found ex-

perimentally, e.g., in proton hydrogen collisions. Even in the low-velocity limit the two-state approximations reproduce these oscillations only qualitatively in position and amplitude. (auth)

1797 APPLICABILITY OF BORN CRITERIA TO CHARGE TRANSFER COLLISIONS. Band, Y. B. (Univ. of Chicago). Can. J. Phys.; 53: No. 5, 465-471(1 Mar 1975).

Born transition matrix elements for rearrangement collisions are discussed. Experimental and theoretical evidence is provided which shows the threshold of validity of the Born criteria in charge transfer reactions being considerably lower than in inelastic and ionization reactions. An explanation for the disparity in the threshold of applicability of the Born criteria is provided. (auth)

1798 INFLUENCE OF THE THERMAL ENERGY AND THE ENERGY DISTRIBUTION OF ELECTRONS ON THE MEASUREMENTS OF ELECTRONIC IMPACT. Delage, A.; Roy, D.; Carette, J. D. (Univ. Laval, Quebec). Can. J. Phys.; 53: No. 6, 628-636 (15 Mar 1975).

The influence of thermal energy of atoms and molecules and of the energy distribution of electrons on results obtained from electronic impact experiments are analyzed. Special attention is devoted to the width of the peaks found in the spectra of elastically and inelastically scattered electrons. Results are presented in the convenient form of tables, graphs, and a nomogram in order that they may be easily accessible to researchers in the field of electronic collisions. The method used to calculate the influences of the experimental factors was also used in the case of resonant elastic scattering of electrons in helium. These experimental factors are the thermal energy of the particles of the target and the spread of the electron energy. (auth)

1799 DIFFERENTIAL CROSS SECTIONS FOR COHERENT PHOTON SCATTERING BY ELEMENTS Z EQUALS 2 THROUGH Z EQUALS 26. Brown, R. T. (Los Alamos Scientific Lab., NM). At. Data Nucl. Data Tables; 15: No. 2, 111-139(Feb 1975).

Graphical displays of the differential cross section for coherent photon scattering are presented for elements Z equals 2 through Z equals 26. The range of photon energies is from 500 eV to 200 keV. The cross sections are theoretical values obtained from atomic form factors calculated with analytic Roothaan–Hartree-Fock wave functions. Form factors calculated in this way differ by at most one per cent from those calculated with much more elaborate correlated wave functions. (25 figures, 1 table) (auth)

1800 COLLISIONS BETWEEN ORIENTED $6^2D_{\frac{5}{2}}$ THALLIUM ATOMS AND INERT GASES. Gelbhaar, B. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). Z. Phys.; 272A: No. 1, 53-59(1975). (In German).

By exciting thallium atoms with circular polarized light of the thallium resonance line 2,768 A an orientation of thallium atoms in the $6^2D_{\frac{5}{2}}$ level can be generated. Our experimental results show that part of this orientation has been transferred to the $6^2D_{\frac{5}{2}}$ thallium level by collisions with inert gas atoms. A series of experiments was carried out using He, Ne, Ar, Kr and Xe as buffer gases. In all cases the direction of the transferred orientation was found to be inverted. (orig)

1801 *K* X—RAY YIELD FROM 100-MeV Pb + Pb COLLISIONS. Meyerhof, W.E. (Department of Physics, Stanford University, Stanford, California 94305); Anholt, R.; Saylor, T.K.; Bond, P.D. Phys. Rev. A 11: No. 3, 1083-1085 (Mar 1975).

Thick-target *K* x-ray yields from Pb + Pb collisions have been measured at two bombarding energies near 100 MeV in order to determine cross sections. The latter fit into a new scaling law for *K*-vacancy production cross sections in symmetric heavy-ion collisions with $Z > 10$. (auth)

1802 GLAUBER CROSS SECTIONS FOR EXCITATION OF THE $2\,^1P$ LEVEL OF HELIUM BY PROTON IMPACT. Chan, F.T.; Chang, C.H. (Physics Department, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. A 11: No. 3, 1097-1100 (Mar 1975).

The Glauber approximation is applied to excitation of $2\,^1P$ level of helium by proton impact with incident energies from 25 to 1000 keV. The theoretical results for the total excitation cross sections are in good agreement with the experimental data of Park and Schowengerdt and of Hippler and Schartner. Comparison is made with other theoretical models. (auth)

1803 DOUBLY DIFFERENTIAL CROSS SECTIONS FOR DOUBLE IONIZATION OF HELIUM BY FAST PROTONS. Snyder, R. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. A 11: No. 3, 1105-1107 (Mar 1975).

Cross sections differential in the angle and energy of ejection of the second ionized electron are presented for the collision process $H^+ + He \rightarrow H^+ + He^{++} + 2e$. (auth)

1804 ARGON AND KRYPTON X—RAY PRODUCTION BY FLUORINE PROJECTILES OF DIFFERENT CHARGE STATES. Czuchlewski, S.J.; Macdonald, J.R.; Ellsworth, L.D. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 11: No. 3, 1108-1113 (Mar 1975).

Kr *K*, Kr *L*, and Ar *K* x-ray yields have been measured for excitation by 36- and 48-MeV fluorine ions in +6 to +9 charge states. The significant decrease in the dependence of the target x-ray yields on the projectile charge state, which is observed as the parameter Z_1/Z_2 is decreased, is in agreement with theoretical expectations. (auth)

1805 EXCITATION OF HYDROGEN ATOMS BY ELECTRON IMPACT AT INTERMEDIATE ENERGIES. Callaway, J.; Wooten, J.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. A 11: No. 3, 1118-1120 (Mar 1975).

The cross sections for the $1s$-$2s$ and $1s$-$2p$ transitions in atomic hydrogen have been calculated for electron impact energies in the range 12–20 eV using a pseudostate expansion. (auth)

1806 ANGULAR DISTRIBUTIONS IN THE ELECTRON IMPACT EXCITATION OF Xe AT 20 eV. Williams, W.; Trajmar, S.; Kuppermann, A. (California Institute of Technology, Pasadena, California 91109). J. Chem. Phys. 62: No. 8, 3031-3035 (15 Apr 1975).

Electron impact energy-loss spectra of Xe have been studied at 20 eV incident electron energy from 5° to 135° scattering angle. Differential and integral cross sections for elastic scattering and for the excitation of electronic states up to 10.60 eV energy loss have been determined. The validity of the optical selection rules and the previously established angular behavior associated with direct and exchange processes were examined for this intermediate coupling case. (auth)

1807 EXCITATION OF THE (5,2) BAND OF THE FIRST POSITIVE BAND SYSTEM OF N_2 BY PROTON IMPACT ON NITROGEN. Suchannek, R.G.; Sheridan, J.R. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). J. Chem. Phys. 62: No. 8, 3036-3038 (15 Apr 1975).

Excitation of the (5,2) band of the first positive band system of N_2 by proton impact on nitrogen was observed in a beam experiment. The intensity of the (5,2) band varied linearly with target gas pressure, and, therefore, the excitation of this band can be attributed to the impact of primary particles on nitrogen molecules. Excitation cross sections were measured for proton energies ranging from 3.35–20.1 keV. The excitation cross section attains its maximum value of 1.2×10^{-18} cm^2 at approximately 5.0 keV and decreases smoothly towards higher proton energies. The measured cross sections seem to fit a Bethe plot. The quadratic pressure dependence of the intensity of the first positive band system, observed during earlier measurements, may have been due to a large contribution of neutral hydrogen atoms to the excitation of the first positive band system, which has masked out the excitation by protons. (auth)

1808 OPTICAL EXCITATION IN COLLISION OF 500–5000 eV H_2^+, He^+, Ne^+, Ar^+, AND N_2^+ IONS WITH CO_2. Bregman-Reisler, H.; Doering, J.P. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 62: No. 8, 3109-3117 (15 Apr 1975).

Electronic excitation of the products of collisions of 500–5000 eV H_2^+, He^+, Ne^+, Ar^+, and N_2^+ ions with CO_2 has been investigated by a spectroscopic study of the optical emissions from the collision products at wavelengths from 3000 to 6500 Å. For H_2^+ and N_2^+ projectile ions, the most important contribution to the observed emissions was from the $A\,^2\Pi_u$ excited state of CO_2^+. For He^+ and Ne^+ impact, however, strong emissions from O I, O II, C I, and C II in high Rydberg states produced by dissociative ionization of CO_2 were observed. Emission from excited molecular dissociation fragments (CO and CO^+) was weak in the latter case, but it was possible to identify fluorescence definitely from the $d\,^3\Delta_i$ and $a'\,^3\Sigma^+$ states of CO and the $A\,^2\Pi$ state of CO^+ as well as to identify tentatively emissions from the $e\,^3\Sigma^-$ and $b\,^1\Sigma^+$ states of CO. Emissions from the projectile ions or fast neutral atoms produced by charge transfer were also observed. The most intense lines produced with He^+, Ne^+, and Ar^+ projectiles originated from the neutral rare-gas atoms in Rydberg states as high as $n=9$. Analysis of the results shows that charge transfer, dissociative charge transfer, and direct excitation channels all contribute to the observed emissions, but the relative importance of the various channels is different for different projectile ions. (auth)

1809 AN APPLICATION OF THE SEMICLASSICAL APPROXIMATION OF THE GENERALIZED PHASE SHIFT TREATMENT OF ROTATIONAL EXCITATION: Ar–N_2. Pattengill, M.D. (Department of Chemistry, University of Kentucky, Lexington, Kentucky 40506). J. Chem. Phys. 62: No. 8, 3137-3142 (15 Apr 1975).

The semiclassical approximation of the generalized phase shift (GPS) treatment of rotational excitation is applied to a previously considered

collision model intended to represent thermal Ar–N_2 scattering. In addition, calculations are performed in the sudden approximation limit. Results obtained are compared at the level of inelastic cross sections with those from previous classical trajectory and classical limit GPS calculations. (auth)

1810 CLOSE COUPLING TEST OF CLASSICAL AND SEMICLASSICAL CROSS SECTIONS FOR ROTATIONALLY INELASTIC Ar–N_2 COLLISIONS. Pack, R.T. (Department of Chemistry, Brigham Young University, Provo, Utah 84602). J. Chem. Phys. 62: No. 8, 3143-3148 (15 Apr 1975).

Accurate quantum mechanical close-coupling (CC) integral cross sections are reported for rotationally inelastic Ar–N_2 collisions at room temperature using an empirical intermolecular potential. These cross sections are used to test the infinite-order sudden (IOS) approximation and the results of several methods [classical trajectories (CT), full sudden (SA), generalized phase shift (GPS), and classical limit generalized phase shift (CGPS)] as reported in the preceding paper by Pattengill. The IOS approximation works very well for cross sections involving low rotational states. The CT method works well for all the cross sections examined, justifying the popular belief that the rotational motion of N_2 is essentially classical at room temperature. (auth)

1811 *K*- AND *L*-SHELL IONIZATION BY ENERGETIC LITHIUM BEAMS. Hopkins, F.; Brenn, R.; Whittemore, A.R.; Karp, J.; Bhattacherjee, S.K. (Department of Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. A 11: No. 3, 916-919 (Mar 1975).

We have measured target *K* x-ray production cross sections for lithium projectiles incident on thin aluminum, scandium, copper, and tin targets at energies from 4 to 34 MeV. The Sn *L* x-ray cross sections for those energies have also been obtained. In addition, similar measurements for protons incident at velocities matching those of the lithium projectiles have been made. The absolute magnitudes of the lithium ionization cross sections as deduced from the above results are well predicted by the binary-encounter approximation. Substantial deviations downward occur in the Sc and Cu cases for projectile velocities below one-half of the *L*-shell electron orbital velocities. These decreases in the cross sections, which are also evident in the data when scaled by the corresponding proton values, are examined in light of a previous treatment of increased binding effects. (auth)

1812 ELECTRON TRANSFER IN keV-ENERGY $^4He^{++}$ ATOMIC COLLISIONS. I. SINGLE AND DOUBLE ELECTRON TRANSFER WITH He, Ar, H_2, AND N_2. Bayfield, J.E.; Khayrallah, G.A. (J. W. Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 11: No. 3, 920-929 (Mar 1975).

Single- and double-electron-transfer cross sections have been measured for a $^4He^{++}$ beam incident on thin He, Ar, H_2, and N_2 gas targets over the energy range 15–125 keV. Comparison with previous $^3He^{++}$ experimental results is made at the same incident particle velocity. For He^{++} collisions with He, we find good agreement with the theory for double electron transfer, but conclude that the single-electron-transfer cross section is far from being understood. Interpretation of the data in terms of simple theoretical ideas indicates that capture into excited states of the He^+ ion can be the dominant single-electron-transfer process in some keV-energy He^{++} atomic collisions. (auth)

1813 ELECTRON TRANSFER IN keV-ENERGY $^4He^{++}$ COLLISIONS. II. FORMATION OF $^4He^+(2s)$ IN COLLISIONS WITH He, Ar, H_2, AND N_2. Khayrallah, G.A.; Bayfield, J.E. (J. W. Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut, 06520). Phys. Rev. A 11: No. 3, 930-941 (Mar 1975).

Cross sections for single-electron transfer forming the metastable state $^4He^+(2s)$ have been measured for a $^4He^{++}$ beam incident on thin He, Ar, H_2, and N_2 gas targets. The $^4He^{++}$ energy range was 7–70 keV. The experiments utilized detection of the 2*s* state via a delayed time coincidence between a field-induced Lyman-α photon and the ion itself. While the measured cross sections are believed accurate to ± 35%, they are three times larger than the recent cross sections of Shah and Gilbody using incident $^3He^{++}$ ions. The present time-coincidence technique directly measured the fraction of the total electron-transfer cross section resulting in metastable production with results ranging between 5% and 17%. (auth)

1814 INELASTIC COLLISIONS INVOLVING EXCITED CESIUM ATOMS AT THERMAL ENERGIES. Cuvellier, J.; Fournier, P.R.; Gounand, F.; Pascale, J.; Berlande, J. (Centre d'Etudes Nucléaires at Saclay, Service de Physique Atomique-BP No.2, 91190-Gif-sur-Yvette, France). Phys. Rev. A 11: No. 3, 846-856 (Mar 1975).

Cross sections for the $7P_{1/2} \rightarrow 6D_{3/2}$ and $7P_{3/2} \rightarrow 6D_{3/2}$ transitions, induced at thermal energies by cesium–rare-gas collisions, have been measured over the temperature range from 420 to 615 K. The values of the cross sections are found to be surprisingly high when considering only the energy defect of the levels involved. Moreover, the cross sections for Cs-He collisions exhibit very different behavior than those corresponding to heavier rare gases. A discussion with the aid of theoretical adiabatic potential curves explains the main features of the experimental results. Theoretical calculations of the cross sections have been carried out for some cases, and give results in satisfactory agreement with the experimental values. (auth)

1815 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC AND INELASTIC SCATTERING OF 15–100-keV Li^+ BY He. Park, J.T.; Pol, V.; Lawler, J.; George, J.; Aldag, J.; Parker, J.; Peacher, J.L. (Physics Department, University of Missouri-Rolla, Rolla, Missouri 65401). Phys. Rev. A 11: No. 3, 857-864 (Mar 1975).

Sets of energy-loss spectra for Li^+ incident on He that were taken at a series of scattering angles were used to calculate differential cross sections. Differential cross sections are given for elastic scattering and for excitation of the He ($n = 2$) states. The differential cross section is also given for excitation of states corresponding to a 60-eV energy loss. These inelastic differential cross sections exhibit maxima at scattering angles greater than zero. The velocity dependence of the cross sections can be compensated by displaying the elastic data in ρ-vs-τ plots and the inelastic data in ρ-vs-$E^{3/2}\theta$ plots. When displayed in terms of these variables, the data are strikingly similar to those reported for Li^+ + He collisions at much lower impact energies. (auth)

1816 CHEMI-IONIZATION IN COLLISIONS OF METASTABLE NEON WITH ARGON. Neynaber, R.H.; Magnuson, G.D. (Intercom Rad Tech, P. O. Box 80817, San Diego, California 92138). Phys. Rev. A 11: No. 3, 865-871 (Mar 1975).

Absolute and relative cross sections were obtained for the Penning-ionization (PI) reaction $Ne^* + Ar \rightarrow Ne + Ar^+ + e$ and the associative-ionization (AI) reaction $Ne^* + Ar \rightarrow NeAr^+ + e$ by a merging-beams technique over a range of interaction energies *W* from 0.01 to 600 eV. The Ne^* represents a composite of $Ne(3s\,^3P_2)$ and $Ne(3s\,^3P_0)$. The PI cross section Q_{Ar^+} rises with decreasing *W* except for a small dip near 0.05 eV and exhibits a rather weak dependence on *W*. For a change of almost five orders of magnitude in *W*, Q_{Ar^+} only changes by about a factor of 7. The AI cross section Q_{NeAr^+} monotonically increases with decreasing *W* and shows a large dependence on *W*. The Q_{NeAr^+} at $W = 0.01$ eV is about 70 times larger than that at 0.5 eV. The total cross section $Q_T = Q_{Ar^+} + Q_{NeAr^+}$ is compared with theoretical and other experimental values. At low *W* our absolute Q_T are considerably larger than those of Tang, Marcus, and Muschlitz although the relative Q_T for both experiments are in fair agreement. (auth)

1817 RELATIVE MULTIPLE IONIZATION CROSS SECTIONS OF NEON BY PROJECTILES IN THE 1–2-MeV/amu ENERGY RANGE. Kauffman, R.L.; Woods, C.W.; Jamison, K.A.; Richard, P. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 11: No. 3, 872-883 (Mar 1975).

The change in the *Kα* x-ray spectra of neon is studied as a function of projectiles of $C^{+3,+4,+5,+6}$, $N^{+4,+6,+7}$, $O^{+4,+5,+6,+7,+8}$, and F^{+9} having an energy between 1 and 2 MeV/amu. The spectra are observed using a curved crystal spectrometer. Combined with previous measurements data are obtained for projectiles from carbon to argon. X rays are observed from different ionization states of Ne designated by KL^n for $n = 1$–7. An 81% correction between the KL^5 peak and KL^6 peak is derived. Semiempirical fluoresence yields are applied to the relative x-ray intensities to obtain relative multiple ionization cross sections. These cross sections are fitted by a binomial distribution as predicted by Coulomb ionization. All cases give good fits except for the F^{+9} induced spectra. A possible explanation is that a different excitation mechanism may exist for this near-symmetric collision case. (auth)

1818 COLLISIONS OF Ne^* (3s) AND Ne^+ WITH Ne: EXCITATION AND CHARGE TRANSFER, ELASTIC SCATTERING, AND DIFFUSION. Cohen, J.S.; Schneider, B. (University of California, Los Alamos Scientific Laboratory, Theoretical Division, Los Alamos, New Mexico 87544). Phys. Rev. A 11: No. 3, 884-892 (Mar 1975).

Results of previous structure calculations by the authors on the ground and excited states of Ne_2 and Ne_2^+ are used to calculate total, diffusion, and excitation-(or charge-) transfer cross sections for collisions of Ne^* ($3s$, $^3P_{2,1,0}$ and $^1P_1$) and $Ne^+(^2P_{3/2,1/2})$ with the ground-state neon atom. The calculations have been carried out both including and excluding spin-orbit coupling, to demonstrate its effect. The influences of curve crossings (and adiabatically avoided crossings), potential maxima, and long-range forces on the magnitude and shape of the cross sections are emphasized. It is shown that the inference of excited-state potential curves from experimental scattering data can be a much more difficult task than is commonly assumed. The calculated cross sections and related quantities are in generally good agreement with the available experimental measurements. (auth)

1819 PROTON-INDUCED *K*-SHELL IONIZATION CROSS SECTIONS FOR SELECTED ELEMENTS Ag TO La: 0.6–2.0 MeV. Khelil, N.A.; Gray, T.J. (Department of Physics, North Texas State University, Denton, Texas 76203). Phys. Rev. A 11: No. 3, 893-900 (Mar 1975).

K-shell x-ray and ionization cross sections are reported for protons on Ag, Cd, Sn, Sb, Te, Ba, and La over the ion energy range of 0.6–2.0

MeV. The data are compared with the predictions of the nonrelativistic plane-wave Born approximation (PWBA), the nonrelativistic PWBA with corrections for binding energy and/or Coulomb deflection, binary-exchange approximation (BEA), and the constrained BEA predictions. In general the nonrelativistic PWBA with binding-energy corrections gives the best over-all agreement with the measurements of proton-induced x-ray processes for the K shells of the elements studied in this work. The data further suggest the need for relativistic PWBA treatment of the interactions in the K shell for the range of binding energies represented by the elements investigated in this work. (auth)

1820 DESTRUCTION OF FAST H(2s) ATOMS BY COLLISIONS WITH He, Ar, H_2, AND N_2. Hughes, R.H.; Berge, P.O. (Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. A 11: No. 3, 906-908 (Mar 1975).

Absolute cross sections for the destruction of hydrogen metastable atoms [H(2s)] have been measured for impact on He, Ar, H_2, and N_2 in the energy range from 20 to 120 keV. Cross sections have also been measured for the collisional ionization of H(2s) by impact on H_2 in this same energy range. The analysis of the collisional destruction of H(2s) includes electron capture into unbound states of the negative ion with subsequent loss of the excited state as one of the quenching mechanisms in this energy range. Collisional ionization (direct electron loss) of the metastable projectile accounts for most of the remaining destruction. Within experimental error, collisional ionization and electron capture can entirely account for the destruction by impact on He. Additional quenching mechanisms are required for impact on the other targets. It is found that about 70% of the noncapture destruction is accounted for by collisional ionization in these cases. The results for destruction by impact on the molecular gases, N_2 and H_2, appear to be adequately explained by the inclusion of dipole-quadrupole electric-field quenching as the third mechanism. (auth)

1821 ABSOLUTE EMISSION CROSS SECTION FOR N_2^+ (3914 Å) FOR PROTONS INCIDENT ON N_2 GAS. Hoffman, J.M.; Lockwood, G.J.; Miller, G.H. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 11: No. 3, 841-845 (Mar 1975).

Absolute cross sections for the emission of the 3914-Å radiation of the N_2^+ first negative system have been measured for protons incident on a gaseous nitrogen target. The energy range covered was 12–100 keV. The energy dependence of the data presented is somewhat different from most previously published data. A possible energy-dependent source of error that may have occurred in previous measurements is discussed. In the present experiment this error should have been minimized by the use of a calorimeter rather than a Faraday cup to measure incident-beam current. (auth)

1822 LOW-ENERGY e^--H_2 ELASTIC CROSS SECTIONS USING DISCRETE BASIS FUNCTIONS. Rescigno, T.N.; McCurdy, C.W. Jr.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109). Phys. Rev. A 11: No. 3, 825-829 (Mar 1975).

Differential elastic cross sections for the scattering of electrons by hydrogen molecules are calculated for incident momenta ≤ 0.7 a.u. Calculations are performed using a Gaussian basis-set expansion technique developed previously by the authors for use with nonspherical potentials. With the static-exchange model, cross sections are computed in the body-fixed frame and then averaged over molecular orientations. Our results agree well with those of previous workers. The method is economical and has wide applicability to the electron-molecule scattering problem. (auth)

1823 CALCULATION OF PROBABILITIES FOR COLLISION–INDUCED TRANSITIONS BETWEEN LEVELS OF HYPERFINE STRUCTURE OF ATOMS. Rebane, V.N.; Petrashen, A.G. Opt. Spectrosc. (USSR) 37: No. 5, 472-475 (Nov 1974).

In the framework of the model of breaking of hyperfine coupling during a collision, a general expression was derived for transition probabilities between levels of hyperfine structure of atoms under the influence of collisions. Transitions probabilities are expressed through constants that describe the collisional relaxation of electronic multipole moments of an atom and through the 6j coefficients that depend on the electronic angular momentum j, the nuclear spin i, the values of total angular momenta F and F_1 for levels between which the transition occurs, and on the order κ of the electron multipole moment. Numerical calculations are performed of transition probabilities between levels of hyperfine structure, induced by nonresonance collisions of atoms having electron momenta $j=1$, 3/2, or 2 and nuclear spins $i=1/2$, 1, 3/2, 2, 5/2, 3, and 7/2 with atoms of inert gases. In the calculations, theoretical values of the relaxation constants of electronic multipole moments were used. They were calculated by numerical integration of equations of the impact parameter method for the model of the dipole–dipole dispersion interaction. The results of the calculations are tabulated. (auth)

1824 ELECTRON IMPACT EXCITATION OF ALKALINE EARTH ATOMS. IV: CALCIUM. Garga, I.I.; Aleksakhin, I.S.; Starodub, V.P.; Zapesochnii, I.P. Opt. Spectrosc. (USSR) 37: No. 5, 482-485 (Nov 1974).

The excitation of calcium atoms by electron impact was studied systematically using the method of intersecting electron and atomic beams. The empirical formula $Q \sim n^{-\alpha}$ (n is the principal quantum number and α the cross section attenuation) was found to describe the effective cross sections of transitions from one–electron excited levels of the singlet term system. The ratio of the sums of the excitation cross sections for radiative transitions from normal and from displaced levels in the singlet term system is shown to be 10:1. An analysis of the energy dependence of the cross sections is made for five series. (auth)

1825 COLLISION OF HIGHLY EXCITED ATOMS. Kazantsev, A.P. Opt. Spectrosc. (USSR) 37: No. 6, 589-590 (Dec 1974).

The dependence of the cross section of broadening and shift is qualitatively investigated as a funciton of the principal quantum number. It is shown that such a dependence is not monotonic. There is qualitative agreement with the experiment. (auth)

1826 POSITRON SCATTERING FROM A HYDROGEN MOLECULE WITH VIBRATIONAL EXCITATION. Baille, P.; Carewych, J. W. (York Univ., Toronto, Ontario (Canada). Dept. of Physics). J. Phys. (Paris), Lett.; 35: No. 12, L.243-L.245 (Dec 1974). (In French).

The elastic scattering of a positron from a hydrogen molecule has been studied in the fixed nuclei approximation, with a one centre formalism, for several internuclear separations. The adiabatic nuclear approximation has then been used to compute (rotational) vibrational excitation cross sections. (FR)

1827 L-SUBSHELL IONIZATION BY PROTON AND ALPHA-PARTICLE BOMBARDMENT OF Ta, Au, AND Bi. Chang, C. N. Columbus, OH; Ohio State Univ. (1974). 147p. University Microfilms Order No. 75-3023.

Thesis (Ph.D.).

Cross sections for ionization of the L/sub I/, L/sub II/, and L/sub III/ subshells in Ta, Au, and Bi have been measured for proton energies from 1.0 to 5.5 MeV and alpha-particle energies from 1.0 to 11.0 MeV. X-ray spectra recorded with a Si(Li) detector were used to deduce the subshell ionization cross sections: L/sub alpha/ components give L/sub III/ subshell ionization cross sections, sigma/sub L_3/, and L/sub gamma/ components were computer analyzed into L/sub $gamma_5$/, L/sub $gamma_1$/, L/sub $gamma_{2+3}$/, and L/sub $gamma_4$/ to give the L/sub II/ and L/sub I/ subshell ionization cross sections, sigma/sub L_2/ and sigma/sub L_1/, respectively. From comparisons between the experimental values and various simple model calculations, it is found that the planewave Born approximation (PWBA) serves as a good framework for describing the mechanism of the L-subshell ionization cross sections in these heavy elements. The necessity of including some small but significant additional effects in the PWBA treatment, such as the binding effect, the Coulomb deflection effect, the relativistic effect, and corrections to the normally assumed hydrogenic wave functions ("Hartree-Fock-Slater effect") is discussed. These must be considered in explaining discrepancies between experiment and theory which are observed at low projectile velocities. The behavior of the ratio sigma/sub L_3//sigma/sub L_2/ at low energies deviates markedly from the PWBA predictions for alpha particles on Au; such a strong deviation is not observed for Ta and Bi. The suggestion that differences in outer-shell electron configuration may underlie this effect was checked by measuring this cross-section ratio for Pt, expected to behave similarly to Au. The deviation was, indeed, observed in Pt. (Diss. Abstr. Int., B)

Atomic Theory

Refer also to abstracts 1693 and 1774.

1828 REDUCTION OF THE MODEL OF HIGHLY IONIZED ATOMS. Rozelot, J. P.; Noens, J. G. (Observatoires du Pic du Midi et de Toulouse, Bagners de Bigorre, France). Can. J. Phys.; 53: No. 6, 650-656(15 Mar 1975).

In numerous studies, in astrophysics for instance, the large number of energy levels belonging to a highly ionized atom becomes rapidly unwieldy; systems are hard to deal with and simplifying assumptions vary from one author to another, since it is difficult to know a priori which levels can be left out of consideration in the study. This often impairs the accuracy of the results. A technique is proposed for reducing the ion model, in terms of its configurations, without neglecting any level. This procedure is applied to the case of Fe^{+10}; the populations of the five lower levels are obtained by solving a system of 10 equations although 89 levels are taken into consideration. (auth)

1829 TECHNIQUES FOR THE CALCULATION OF ATOMIC STRUCTURES AND RADIATIVE DATA INCLUDING RELATIVISTIC CORRECTIONS. Eissner, W. (University Coll., London); Jones, M.; Nussbaumer, H. Comput. Phys. Commun.; 8: No. 4, 270-306 (Nov 1974).

The theory incorporated in a general-purpose automatic atomic-structure program is formulated in detail. The computer program, which is called SUPERSTRUCTURE, will be published soon. SUPERSTRUCTURE can calculate term energies, intermediate-coupling energy levels, term-coupling coefficients, radiative data which includes permitted and forbidden transition probabilities, and cascade coefficients. The program uses multi-configuration type expansions. Relativistic corrections are made by means of the Breit–Pauli approximation. Special attention is paid to those features of the formulation which make it particularly suited to the computer. Such principal features are: Wave functions are effectively expanded in Slater determinants. Expressions for the matrix elements of the relativistic operators are given in a concise form. These matrix elements are expressed in terms of coefficients $c_\lambda(lm, l'm')$, related to the corresponding coefficients of Condon and Shortley, and coefficients $d_\lambda(lm, l'm')$, which are introduced. Relativistic operators whose matrix elements have similar angular parts are grouped together to avoid superfluous calculation of angular coefficients. Radial functions can be either statistical-model functions of user-supplied functions. SUPERSTRUCTURE will calculate the statistical-model radial functions if they are required, and user-supplied functions will be processed to suit the internal requirements of the program. Checking procedures used for testing the various parts of SUPERSTRUCTURE are discussed. Also a critique is given of the techniques described, and, where appropriate, they are discussed in relation to techniques used by other workers. The wide range of atomic structure data which the program can calculate makes it highly suitable for astrophysical applications. The formulation developed should be of wide application in various problems relating to atomic structure. (auth)

1830 CALCULATION OF THE HYPERFINE INTERACTION USING AN EFFECTIVE-OPERATOR FORM OF MANY-BODY THEORY. Garpman, S.; Lindgren, I.; Lindgren, J.; Morrison, J. (Chalmers University of Technology and the University of Göteborg, Göteborg, Sweden). Phys. Rev. A 11: No. 3, 758-781 (Mar 1975).

The effective-operator form of many-body theory is reviewed and applied to the calculation of the hyperfine structure. Numerical results are given for the $2p$, $3p$, and $4p$ excited states of Li and the $3p$ state of Na. This is the first complete calculation of the hyperfine structure using an effective-operator form of perturbation theory. As in the Brueckner-Goldstone form of many-body theory, the various terms in the perturbation expansion are represented by Feynman diagrams which correspond to basic physical processes. The angular part of the perturbation diagrams are evaluated by taking advantage of the formal analogy between the Feynman diagrams and the angular-momentum diagrams, introduced by Jucys *et al.* The radial part of the diagrams is calculated by solving one- and two-particle equations for the particular linear combination of excited states that contribute to the Feynman diagrams. In this way all second- and third-order effects are accurately evaluated without explicitly constructing the excited orbitals. For the $2p$ state of Li our results are in agreement with the calculations of Nesbet and of Hameed and Foley. However, our quadrupole calculation disagrees with the work of Das and co-workers. The many-body results for Li and Na are compared with semiempirical methods for evaluating the quadrupole moment from the hyperfine interaction, and a new quadrupole moment of ^{23}Na is given. (auth)

1831 RADIATION REACTION AND VACUUM FLUCTUATIONS IN SPONTANEOUS EMISSION. Milonni, P.W. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Smith, W.A. Phys. Rev. A 11: No. 3, 814-824 (Mar 1975).

A Heisenberg-picture treatment of spontaneous emission is given, and the origin of radiative line shifts and widths is discussed. It is shown that radiation reaction and vacuum fluctuations provide complementary conceptual bases for the interpretation of these radiative corrections. Alternative approaches are discussed, including the use of a random classical field to simulate the effects of the quantum electrodynamical radiation field. (auth)

1832 MULTITIME-CORRELATION FUNCTIONS AND THE ATOMIC COHERENT-STATE REPRESENTATION. Narducci, L.M.; Bowden, C.M. (Quantum Physics, Physical Sciences Directorate, Redstone Arsenal, Alabama 35809); Bluemel, V.; Garrazana, G.P.; Tuft, R.A. Phys. Rev. A 11: No. 3, 973-980 (Mar 1975).

We consider the evaluation of multitime-correlation functions for quantum statistical systems characterized by dynamical variables of the angular-momentum type (such as, for example, paramagnetic or nuclear spins or collections of two-level atoms), and show how the atomic coherent-state representation of Arecchi *et al.* can be used to express the multitime averages in terms of phase-space integrals. Our calculation suggests a convenient classical-quantum correspondence rule for angular-momentum degrees of freedom. (auth)

1833 LOWER BOUND TO THE ENERGY OF COMPLEX ATOMS. Hertel, P. (Institut für Theoretische Physik der Universität Wien, A-1090 Wien, Boltzmanngasse 5, Austria); Lieb, E.H.; Thirring, W. J. Chem. Phys. 62: No. 8, 3355-3356 (15 Apr 1975).

There are methods available for calculating rather precise lower bounds for the energy of simple atoms or molecules. If complex atoms or molecules are to be investigated, these methods become inapplicable, or impracticable. Here we propose a new method which, for the above cases, promises to become as accurate as the Hartree–Fock procedure for the upper bound. Although applicable to a wider class of problems, we shall demonstrate it for an atom with N electrons. (AIP)

PHYSICS (HIGH-ENERGY)

1834 PHYSIK: GRUNDLAGE DER TECHNIK. (Physics: Principals of Technology. 38th General Meeting of the German Physical Society, Nuremberg, Germany, September 23–27, 1974). Weinheim, Ger.; Physik Verlag, GmbH (1974). 473p. (CONF-740976-). (In German and English).

The 20 addresses delivered in plenary sessions are compiled. They include articles on physics principles, energy, materials, data processing and communication, medical and environmental techniques, and education. Separate abstracts were prepared for seven of the articles. (JSR)

For abstracts of individual papers see: 333, 1532, 1871, 1915, 1922, 2139, and 2165.

1835 PROGRESS IN PARTICLE PHYSICS. Proceedings of the XIIIth International Conference, Graz, Austria, February 4–15, 1974. Urban, P. (ed.). Acta Physica Austriaca, Supplementum XIII. Vienna; Springer-Verlag (1974). 778p. (CONF-740245-). $60.70.

Sixteen lectures are presented. A separate abstract was prepared for each lecture. (LBS)

For abstracts of individual papers see: 1842, 1852, 1859, 1860, 1872, 1879–1882, 1899, 2136–2138, and 2147–2149.

Particle Interactions and Properties (Experimental)

1836 (COO-3017-132) PROPOSAL FOR RESEARCH PROJECT, HIGH ENERGY PHYSICS RESEARCH FOR FISCAL YEAR 1976. Renewal and Progress Report. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1 Apr 1975. Contract AT(11-1)-3071. 96p. Dep. NTIS $8.00.

Research on experimental high energy physics and theoretical high energy, nuclear, and astrophysics is summarized. A list of publications is included. (JFP)

Electromagnetic

1837 (DESY-74/62) A MEASUREMENT OF COLLINEAR AND NEARLY COLLINEAR PHOTON PAIRS PRODUCED BY e^+e^- ANNIHILATION AT THE 3100 MeV RESONANCE. DASP Collaboration. Braunschweig, W.; Jordan, C. L.; Martyn, U.; Sander, H. G.; Schmitz, D.; Sturm, W.; Wallraff, W.; Berkelman, K.; Cords, D.; Felst, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Dec 1974. 7p. INIS.

3 figs.; 6 refs.

Collinear and nearly collinear photon pairs from e^+e^- annihilation at total energies covering the resonance at 3,100 MeV were measured. The observed cross section is in good agreement with the $e^+e^- \rightarrow \gamma\gamma$ cross section expected from quantum electrodynamics. Upper limits for the decay modes $(3,100) \rightarrow \gamma\gamma$, $\pi^0\gamma$ and other modes are derived. (auth)

1838 QUASIELASTIC (e,e'p) AND (e,e'd)-SCATTERING AND INELASTIC SCATTERING FROM ^{6}Li WITHIN THE $\Delta(1,236)$-RESONANCE REGION. Heimlich, F. H. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). 3 May 1973. 75p. (In German). INIS.

Available from the library of the Freiburg Univ.

Quasielastic cross sections are measured using coincidence-techniques at electron energies of 2.5 and 2.7 GeV and proton momentum transfer of 6.6 fm^{-2}, 10.0 fm^{-2}, and 11.6 fm^{-2}. Electron spectra without coincidence are taken simultaneously in the region of quasielastic scattering and $\Delta(1,236)$-resonance up to an invariant mass of approximately 1.5 GeV. The results are discussed. (GE)

1839 TOTAL CROSS SECTION FOR HADRON PRODUCTION BY ELECTRON-POSITRON ANNIHILATION BETWEEN 2.4 AND 5.0 GeV CENTER-OF-MASS ENERGY. Augustin, J.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Dakin, J.T.; Feldman, G.J.; Fischer, G.E.; Fryberger, D.; Hanson, G.; Jean-Marie, B.; Larsen, R.R.; Lüth, V.; Lynch, H.L.; Lyon, D.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Richter, B.; Schwitters, R.F.; Vannucci, F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Abrams, G.S.; Briggs, D.; Chinowsky, W.; Friedberg, C.E.; Goldhaber, G.; Hollebeek, R.J.; Kadyk, J.A.; Trilling, G.H.; Whitaker, J.S.; Zipse, J.E. Phys. Rev. Lett. 34: No. 12, 764-767 (24 Mar 1975).

The total cross section for hadron production by e^+e^- annihilation has been measured at center-of-mass energies between 2.4 and 5.0 GeV. Aside from the very narrow resonances ψ (3105) and ψ (3695), the cross section varies between 32 and 17 nb over this region with structure in the vicinity of 4.1 GeV. (auth)

1840 SCALING BEHAVIOR OF INCLUSIVE PION ELECTROPRODUCTION. Bebek, C.J.; Brown, C.N.; Herzlinger, M.; Holmes, S.D.; Lichtenstein, C.A.; Pipkin, F.M.; Raither, S.; Sisterson, L.K. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 12, 759-761 (24 Mar 1975).

We report new measurements of inclusive pion electroproduction. Data were taken with deuterium and hydrogen targets at the W and Q^2 points (2.15 GeV, 1.2 GeV^2), (2.15, 4.0) and (3.11, 1.2) and with only hydrogen at (2.15, 2.0), (2.67, 0.6), (2.67, 1.2), (2.67, 2.0), (2.67, 3.3), and (3.11, 1.7). The invariant structure function and the π^+/π^- ratio are studied as a function of Q^2, W, and ω. (auth)

Weak

Refer also to abstracts 921 and 1871.

Strong (Baryon-induced)

Refer also to abstract 920.

1841 (UCD-34P191-7) U.C. DAVIS HIGH ENERGY PARTICLE PHYSICS RESEARCH, APRIL 1974–JANUARY 31, 1975. Annual Progress Report. Kiems, J.; Ko, W.; Lander, R. L.; Pellett, D. E.; Yager, P. M. (California Univ., Davis (USA). Dept. of Physics). Feb 1975. Contract AT(04-3)-34. 6p. Dep. NTIS $4.00.

Measurements of the 100 GeV pi$^+$p and pp film were finished. Two Physical Review Letters on this work were published and a Comment submitted to PRL. A paper describing the V^0's and gamma's was also submitted. The DELTA^{++} production in these data was reported at the Anaheim APS meeting, as were multiplicity distributions for 200 GeV pi$^+$p interactions and 200 GeV pi$^-$d interactions. A charm search is underway in the pi-d film using data from muon counters installed by UCD behind the bubble chamber. Inclusive production of K^{*0}, K^{*+}, and phi^0 in 12 GeV K^+p interactions was studied, and an abstract submitted for the Washington, D. C. APS meeting. A calorimeter was built and calibrated for use in a charm search and high P/sub T/ experiment at FNAL. A proposal to study hadronic interactions in the FNAL 15-foot bubble chamber was approved. (auth)

1842 RECENT RESULTS OF THE EXPERIMENTAL ANALYSIS OF HADRONIC HIGH ENERGY INTERACTIONS. Markytan, M. (Institut fuer Hochenergiephysik, Vienna). Acta Phys. Austr., Suppl.; No. 13, 117-289(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

Some recent results are discussed under the following topics: elastic scattering; amplitude analysis of some quasi-two-body reactions at medium energies; pion exchange reactions; analysis of the three meson system in the reactions $\pi p \rightarrow (3\pi)p$ and $Kp \rightarrow (K2\pi)p$ and of the $(\pi\omega)$ and $(K\omega)$ systems in $\pi(K)p \rightarrow \pi(K)\omega p$; diffraction dissociation and multiplicity distributions. (LBS)

1843 OBSERVATION OF ANTIPROTONIC X RAYS IN ^{6}Li AND ^{4}He. Eckhause, M.; Kane, J.R.; Roberts, B.L.; Welsh, R.E. (College of William and Mary, Williamsburg, Virginia 23185); Redwine, R.P.; Segel, R.E.; Barnes, P.D.; Eisenstein, R.A.; Lam, W.C.; Miller, J.; Sutton, R.B.; Jenkins, D.A.; Powers, R.J.; Kunselman, A.R. Phys. Rev. C 11: No. 3, 1056-1058 (Mar 1975).

We have observed the $3d \rightarrow 2p$ x ray in antiprotonic atoms of ^{4}He. The same transition was absent in antiprotonic ^{6}Li but the $4f \rightarrow 3d$ line was present. The data are analyzed for strong interaction widths. (auth)

1844 CHARGE AND MULTIPLICITY FLUCTUATIONS IN 205-GeV/c *pp* INTERACTIONS. Kafka, T.; Engelmann, R.; Pratap, M. (State University of New York at Stony Brook, Stony Brook, New York 11790); Cho, Y.; Fields, T.H.; Hyman, L.G.; Singer, R.; Voyvodic, L.; Walker, R.; Whitmore, J. Phys. Rev. Lett. 34: No. 11, 687-690 (17 Mar 1975).

Results on charge and multiplicity fluctuations in 205-GeV/c *pp* interactions are presented. The data are shown to be consistent with a simple picture of independent emission of low-multiplicity clusters, rather than of single pions, for the major part of the inelastic *pp* cross section. (auth)

Strong (Meson-induced)

Refer also to abstract 1881.

1845 (AED-CONF-74-306-008) PARTICULAR PROPERTIES OF HADRONIC (EXOTIC) ATOMS. Backenstoss, G. (Basel Univ. (Switzerland)). 1974. 28p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

After a few introductory remarks concerning the definition of exotic atoms and the experimental techniques to produce and observe them, a discussion is given of those properties of the exotic atoms which constitute the main differences between ordinary electronic and exotic atoms. Finally it is demonstrated that the investigation of the particular effects in exotic atoms provides tools for the study of a wide range of physical problems. (GE)

1846 (FRNC-TH-499) STUDY OF Q AND L SYSTEMS PRODUCED IN K^-p INTERACTIONS AT 3.9 GeV/c AND 14.3 GeV/c. Drevillon, B. (Paris-11 Univ., 91 – Orsay (France)). 1973. 141p. (In French). INIS.

The work on the production of Q^- and L^- ($K\pi\pi^-$) systems in K^-p interactions at 3.9 and 14.3 GeV/c involve a study of the two mass ($K\pi\pi^-$) zones: Q^- $M < 1.5$ GeV, L^- $1.5 < M < 2.0$ GeV, with special reference to the reactions $K^-p\,K^-p\pi^+\pi^-$, $K^-p\,\bar{K}^0p\pi^-\pi^0$ and $K^-p\,K^0\pi^+\pi^-n$. The differential cross sections and their slope, the isospin exchange, the conservation helicity, the spin-parity state, the $K\pi\pi$ mass spectra, the decay modes, the decay angular distributions and the Dalitz diagram in the Q region were investigated. The results show the complexity of the Q and L systems and it is difficult to establish their nature. An interpretation of Q in terms of a single resonance may however be excluded. A π exchange model cannot entirely interpret the production of Q, but the similarity of the decay angular distributions of $(K\pi)^0$ systems produced in $K^-p\,K^-p\pi^+\pi^-$ and $K^+p\,K^+\pi^-\,^{++}$ reactions suggests that this π exchange mechanism is present in Q and L production. In this connection Q and L can be explained by mechanism of incident K decay into $K^*(890)\pi$, $K^*(1420)\pi$ etc. interfering with one or more resonances. Similarly the Q production mechanisms, especially the analogy with Kp elastic scattering, can be interpreted in the context of the two-resonance model, suggested by the Dalitz diagram adjustments. (FR)

1847 Σ-HYPERONIC ATOMS. Bunaciu, T. (Karlsruhe Univ. (TH) (F. R. Germany). Fakultaet fuer Physik). 1 Jun 1973. 73p. INIS.

Available from the library of the Karlsruhe Univ.

The first complete and detailed study of Σ-hyperonic atoms with data obtained on nine different targets (Z = 5 to 56) is presented. It provides completely new information regarding two important aspects: a) the Σ^--atomic formation probability, and hence the Σ production rate, has been studied as a function of the target atomic number; b) strong interaction effects in Σ^--hyperonic atoms yielded information about Σ-nucleus interactions. (GE)

1848 MUONIC AND HADRONIC ATOMS. Anderson, D. K.; Jenkins, D. A. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 457-492 of Nuclear Spectroscopy and Reactions, Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The general features of muonic and hadronic atoms are discussed. The former discussion stresses mainly the dominant electromagnetic interaction, and comparisons of theoretical and experimental energy levels are presented. The hadronic atom treatment emphasizes the pion-nucleus interaction. A brief examination of the cascade process and a qualitative description of the manner in which transition x-rays are affected by nuclear interactions are given. (3 figures, 12 tables, 67 references) (SDF)

1849 OBSERVATION OF THE HYPERNUCLEI $_\Lambda{}^{16}O$ AND $_\Lambda{}^{27}Al$. Bonazzola, G.C.; Bressani, T.; Chiavassa, E.; Dellacasa, G.; Fainberg, A.; Gallio, M.; Mirfakhrai, N.; Musso, A.; Rinaudo, G. (Istituto di Fisica Superiore dell'Università, Torino, Italy). Phys. Rev. Lett. 34: No. 11, 683-686 (17 Mar 1975).

The (K^-,π^-) reaction on ^{16}O and ^{27}Al at $p_{K^-} = 390$ MeV/c with forward emitted π^- (Feshbach-Kerman kinematics) was studied. Formation of $_\Lambda{}^{16}O$ and $_\Lambda{}^{27}Al$ was observed. Experimental energy spectra are compared with some theoretical predictions. (auth)

1850 SEARCH FOR BACKWARD A_1 AND A_2 PRODUCTION IN $\pi^-p\to p\pi^-\pi^+\pi^-$ AT 8 GeV/c. Abashian, A.; Beamer, N.; Bross, A.; Eisenstein, B.; Gelfand, N.; Hansen, J.D.; Mollet, W.; Morris, G.R.; Nelson, B.; O'Halloran, T.; Orr, J.R.; Rhines, D.; Schultz, P.; Sokolsky, P.; Wagner, R.G. (University of Illinois at Urbana-Champaign, Urbana, Illinois 61801); Watson, J.; Buttram, M. Phys. Rev. Lett. 34: No. 11, 691-694 (17 Mar 1975).

Backward meson production in the reaction $\pi^-p\to p\pi^-\pi^+\pi^-$ has been studied with use of a streamer chamber triggered by the detection of a fast forward proton. For $\cos\theta^* < -0.98$ we find no evidence of A_1 or A_2 production, and we determine total backward cross-section upper limits (95% confidence) of 0.93 and 0.72 μb, respectively. At $m_{3\pi} = 1.9$ GeV/c^2 we observe a broad enhancement of about 3-standard-deviation significance. Evidence for backward quasi-two-body production is seen in the $\rho^0p\pi^-$ and $f^0p\pi^-$ channels. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 1836 and 2109.

1851 (INIS-mf-1684) SUMMARIES OF CONTRIBUTED PAPERS. Slobodrian, R. J. (Laval Univ., Quebec City (Canada)). Aug 1974. 141p. (In French and English). INIS.

From international conference: a few body problems in nuclear and particle physics; Quebec City, Quebec, Canada (27 Aug 1974).

Abstracts are given of a large number of papers on general few body problems, nucleon-nucleon interaction at all energies, meson-nucleon and meson-deuteron interactions, meson factories programmes, nuclear bremsstrahlung, on-shell and off-shell interactions, final-state interactions, bound and scattering states, few-body forces, polarization phenomena, short range correlations, quasi-free scattering, composite hadron models, subnucleon structure, multiparticle and coherent production processes, break-up reactions, electrodisintegration, and relativistic effects. (INIS)

1852 MELOSH TRANSFORMATION AND THE PYRCE–TANI–FOLDY–WOUTHUYSEN TRANSFORMATION. Bell, J. S. (CERN, Geneva). Acta Phys. Austr., Suppl.; No. 13, 395-445 (1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

An attempt is made to show the relation of the ideas of Melosh to older ideas based on the Foldy-Wouthrysen description of spin for relativistic particles. (LBS)

1853 ABOUT ANTIPARTICLES. Caubet, J. P. (Poitiers Univ., 86 (France)). Compt. Rend., Ser. A, B; 279: No. 7, 247-250(12 Aug 1974). (In French).

The scattering field associated with an antiparticle is built in a probabilistic way. (FR)

Electromagnetic

Refer also to abstract 2145.

1854 (DESY-L-Ueb-186) POLARIZATION PHENOMENA IN PION ELECTROPRODUCTION. Omelaenko, A. S. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). 1974. 9p. (In German). INIS.

12 refs. Published in Ukrainskii Fiz. Zh. v. 19(4) p. 596-602.

A complete description of all the measurable characteristics (asymmetry, polarization of recoil nucleon depolarization tensor) in terms of the center-of-mass system amplitudes of the reaction of pion electroproduction by polarized electrons was performed by means of one-photon exchange approximation. (auth)

1855 (JINR-P4-8554) ENERGY SPECTRUM OF ELECTRON IN A DISORDERED CHAIN OF DELTA FUNCTION POTENTIALS. Karaivanov, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The problem of energy spectrum of electron in a lattice of various delta function potentials is considered. The lattice is enclosed between infinitely high walls. In the case when the potentials are of the same type (wells or barriers) with limit intensities the singularities in the density of states were found. (auth)

1856 (UCRL-Trans-10837) ELECTRON–ELECTRON BREMSSTRAHLUNG IN THE NONRELATIVISTIC CASE. Fedyushin, B. K. Translated from Zh. Eksp. Teor. Fiz.; 22: No. 2, 140-142(1952). 6p. Dep. NTIS $4.00.

Electron-electron bremsstrahlung is considered in the nonrelativistic case taking the exchange into account, and an estimate is made of the mean electron-energy losses in matter as a result of the radiation drag on the electrons. (auth)

1857 SOURCE THEORY VIEWPOINTS IN DEEP INELASTIC SCATTERING. Schwinger, J. (Univ. of California, Los Angeles). Proc. Nat. Acad. Sci. U.S.A.; 72: No. 1, 1-5(Jan 1975).

The phenomena of deep inelastic electron scattering on single nucleons, viewed as virtual photon absorption, are reexamined with the nonspeculative, phenomenological attitude of source theory. The use of a double spectral representation for forward scattering, and of experimental inputs from the low energy resonance region and the high energy real photon diffraction region, lead naturally to the general observed characteristics of deep inelastic scattering. A reasonably successful description of deviations from simple scaling behavior is also presented. (auth)

1858 RESONANCES, FORM FACTORS, AND THE HADRONS SPECTRUM IN INELASTIC ELECTRON–PROTON SCATTERING. Konetschny, W.; Steiner, F. (CERN, Geneva). Lett. Nuovo Cim.; 12: No. 12, 463-469(22 Mar 1975).

The general resonance model is formulated for the absorptive part of the Compton amplitude including both spin and the Hagedorn spectrum of hadronic states. Such a model should be reasonable for the nondiffractive part of the amplitude (ω small). It turns out that the requirement of scaling places rather stringent conditions on the form factors of the resonances: as a function of the excitation mass they have to fall off exponentially. This is a direct consequence of the exponential nature of the hadronic spectrum. (JFP)

1859 ELECTROMAGNETIC INTERACTION OF HADRONS WITHOUT PARTONS. Stichel, P. (Univ., Bielefeld, Ger.). Acta Phys. Austr., Suppl.; No. 13, 447-486(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The non-perturbative covariant parton model (Cambridge parton model) and its deficiencies are discussed. The phenomenological Bethe-Salpeter kernels for the hadron-hadron interaction is considered as the basic strong interaction force. A discussion of electromagnetic processes within this framework leads to a parton-like behavior of hadrons in the scalar coupling case for $Z_2 > 0$. (LBS)

1860 UNIFIED MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Pietschmann, H. (Vienna Univ.). Acta Phys. Austr., Suppl.; No. 13, 535-568(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The development of the last few years which has led to a possibility of unifying quantum electrodynamics with weak interactions is discussed. The topics discussed include: common and different features of quantum electrodynamics and standard weak interactions; the Salam–Weinberg model; the problem of masses and the Higgs phenomenon; the problem of hadrons; and some tests of the model. (LBS)

1861 ELECTRIC DIPOLE MOMENT OF LEPTONS AND POLARIZATION EXPERIMENTS. Bogush, A. A.; Chan Kuok Chan. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 120-122(1974). (In Russian).

A calculation is made of the differential cross section of elastic scattering of a lepton (electron or muon) on a scalar particle (alpha particle or π-meson) with all possible states of polarization of the light particle before and after the reaction being taken into account. Phenomenological form factors responsible for possible violations of γ_5- and CP-(T-) invariance in quantum electrodynamics are introduced into the vertex operator of the electromagnetic interaction of the lepton. It is shown that at the limit of high energies on taking into account the transverse polarization of the lepton in the plane of the reaction before and after scattering it is possible in principle to determine separately from measured scattering cross sections all three form factors of the light particle which were introduced. Thus, for example, the presence of a dynamic electric dipole moment in the electron (muon) can be verified. (SJR)

1862 THERMODYNAMICS OF STRONG INTERACTIONS. Hagedorn, R. (CERN, Geneva). pp 643-716 of Cargese Lectures in Physics, Vol. 6, Schatzman, E. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Particle and cosmic physics are related in the discussion of the thermodynamics of strong interactions. This discussion includes a recapitulation of statistical thermodynamics, introduction to particle physics, the structure of hadron thermodynamics, the solution of the bootstrap in canonical formulation, and applications and results for microscopic quantities, namely; momentum distributions and particle production rates. (JFP)

1863 ANALYSIS OF THE TRANSFER OF PARTIALLY POLARIZED RADIATION. Acquista, C. R. Hoboken, NJ; Stevens Inst. of Tech. (1974). 87p. University Microfilms Order No. 75-2804.

Thesis (Ph. D.).

The transfer of partially polarized radiation is analyzed in terms of a newly defined density matrix distribution function. Equations are formulated to describe the transfer of radiation through an atmosphere composed of arbitrary scatterers for the case where the scatterers are at rest, and then generalized to the case where the scatterers are in an arbitrary state of motion. The terms of the transfer equation are exhibited for Compton scattering, Rayleigh scattering, Thomson scattering and bremsstrahlung. Finally, the effects of an external magnetic field on radiative transfer are examined, and the terms in the transfer equation due to synchrotron emission are exhibited. (Diss. Abstr. Int., B)

1864 SCATTERING OF ELECTROMAGNETIC WAVES ON NEUTRAL FERMIONS HAVING MAGNETIC AND ELECTRIC MOMENTS. Bagrov, V. G.; Bozrikov, P. V.; Gitman, D. M.; Klimenko, Yu. I.; Khudomyasov, A. I. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 138-139(1974). (In Russian).

The scattering of electromagnetic waves on neutrons having an abnormal magnetic moment was previously examined theoretically. This work is extended to the case of neutrons with both magnetic and electric moments. Expressions are derived for the characteristic radiation of a particle which are correct for any total moments. (JSR)

1865 ELECTRON IN PARALLEL-ALIGNED FIELDS OF CLASSICAL AND QUANTIZED PLANE WAVES. Bagrov, V. G.; Gitman, D. M.; Kuchin, V. A. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 60-64(1974). (In Russian).

The Dirac equation was precisely solved for an electron interacting with quantized and classical plane waves with coinciding directions. It was shown that in the case given the system can be examined as consisting of non-interacting quasiparticles. (tr-auth)

1866 ELECTRON-POSITRON ANNIHILATION AT AND ABOVE THE THRESHOLD FOR PRODUCTION OF CHARMED HADRONS. Kogut, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853); Susskind, L. Phys. Rev. Lett. 34: No. 12, 767-770 (24 Mar 1975).

Charmed-quark models of the new narrow resonances at 3.1 and 3.7 GeV suggest that a virtual S state lies slightly above the charmed-hadron threshold. This state causes a large enhancement of $R=\sigma(e^+e^-\to\text{hadrons})/\sigma(e^+e^-\to\mu^+\mu^-)$ just above the threshold, followed by a dip and several broad but smaller enhancements at higher energy. Estimates of this intriguing structure in R are presented. (auth)

Weak

Refer also to abstracts 1666 and 1861.

1867 (DESY-L-Ueb-189) POSSIBLE RESONANCE INTERACTIONS OF COSMIC-RAY NEUTRINOS WITH ELECTRONS AND NUCLEONS. Dedenko, L. G.; Zheleznykh, I. M.; Eidus, V. L. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 7p. (In German). INIS.

Published in Izv. Akad. Nauk. SSSR, v. 38(5), 1974, p. 1056-1059.

Effective cross sections for neutrinos with electrons and nucleons are calculated making certain assumptions as to the properties of the virtual vector mesons in the Lee model and a possible influence on the muon current in the ground is investigated. (GE)

1868 FROISSART BOUND FOR WEAK-SCATTERING AMPLITUDES. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 12: No. 12, 450-454(22 Mar 1975).

A study is made of the asymptotic bounds on the total cross sections of weak scattering processes. The elastic scattering of neutrinos is considered. Using the assumptions of analyticity, crossing, unitarity, polynomial boundedness and a zero condition on the absorptive part of the scattering amplitude, it is shown that the elastic $\nu-\nu$ scattering amplitude obeys the Froissart bound. (JFP)

1869 BOUNDS ON WEAK-INTERACTION AMPLITUDES. II. Mickens, R. E. (Massachusetts Inst. of Tech., Cambridge). Lett. Nuovo Cim.; 12: No. 12, 447-449(22 Mar 1975).

It is shown that a bound may be obtained on weak amplitudes under a more general assumption on the functional form of the scattering amplitude at asymptotic energies than that used previously. Use is made of a previous unitarity relation. For simplicity, the elastic scattering of a neutrino and a scalar particle of mass m. The aim is to obtain a bound on the total cross section for this process in the asymptotic energy region. The main result is the conclusion that the total cross section for weak scattering processes is bounded by an arbitrarily small power of the energy in the asymptotic energy region. (JFP)

1870 SYMMETRIES OF NEUTRAL WEAK CURRENTS. Cordes, J. G.; Kiang, D.; Tsai, S. Y. (Dalhousie Univ., Halifax, Nova Scotia). Can. J. Phys.; 53: No. 6, 617-627(15 Mar 1975).

The $U_2 \times U_2$ and D symmetries of the leptonic weak interaction are extended, within the framework of the quartet–quark model, so as to include the hadronic weak interaction. The total weak current satisfies a lepton–quark symmetry. Application of these symmetries to the neutral current weak interaction restricts the current to be composed only of vector and axial vector pieces, and also restricts the symmetry properties of its (V–A) part. Experimental implications of these symmetries in various neutrino reactions are investigated. There are some ambiguities as regards the (V + A) part of the neutral current, which may, however, be resolved soon if more experimental data becomes available. (auth)

1871 NEUTRAL CURRENTS: A FUNDAMENTAL EXPANSION OF WEAK INTERACTIONS. von Krogh, J. (Technische Hochschule, Aachen). pp 24-70 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German).

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

As an introduction to the discussion of recent experimental and theoretical studies on neutral currents, the forces between elementary particles are described. The principal research efforts in the search for neutral currents are reported. The unified theories developed to describe neutral currents are outlined and compared with experimental data. (JSR)

1872 WEAK INTERACTIONS OUTSIDE THE LABORATORY. Marx, G. (Eoetvoes Univ., Badapest). Acta Phys. Austr., Suppl.; No. 13, 569-594(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The role of weak interactions in nature is considered. Various phenomena occurring in the earth, sun, universe, galaxy, and in living matter that can be related to the weak interaction force are discussed. (auth)

1873 WEAK INTERACTION OF QUARKS. Kurdgelaidze, D. F. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 30-36(1974). (In Russian).

A theory of weak interaction of quarks was developed in the framework of SU(2) symmetry. The decay probabilities of the quarks into leptoquarks, quarks into leptons, and leptoquarks into leptons were determined. A model of the interaction of quarks with matter in which weak and electromagnetic interactions of the quarks with the matter are forbidden was also constructed. In this model the interaction of quarks is the basic form of the interaction of quarks with matter. A search for quarks in nature from the products of their weak decay corresponding to the theory developed was proposed. (tr-auth)

1874 EFFECT OF ANOMALOUS NEUTRAL-CURRENT INTERACTIONS IN THRESHOLD PION PRODUCTION BY NEUTRINOS. Branco, G.; Hagiwara, T.; Mohapatra, R.N. (Department of Physics, The City College of The City University of New York, New York, New York 10031). Phys. Rev. Lett. 34: No. 11, 703-705 (17 Mar 1975).

Using the techniques of current algebra and soft-pion extrapolation, we have calculated the effect of weak neutral-current interactions involving scalar and pseudoscalar densities on the reaction $\nu+n\to\nu+p+\pi^-$ around the threshold region. We find that, although the magnitude of the differential cross section (which depends on quark masses) can be of order 10^{-40} cm^2/(20 MeV), the general shape is different from the one observed experimentally. (auth)

1875 COMMENT ON NONLEPTONIC DECAYS OF CHARMED HADRONS. Pais, A.; Rittenberg, V. (The Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 34: No. 11, 707-709 (17 Mar 1975).

Within the framework of a U(4) symmetry, a discussion of the nonleptonic decays of charmed hadrons under the assumption of pentadecaplet dominance leads to conclusions which may be relevant to impending charmed-particle searches. (auth)

Strong (General)

1876 CENTRAL DIFFRACTIVE PRODUCTION. Bialkowski, G.; Kalinowski, J. (Univ., Warsaw). Acta Phys. Pol.; B6: No. 1, 49-57(1975).

The topological cross sections and some characteristics of the multiplicity distribution for central diffractive production via double pomeron exchange are discussed. (auth)

1877 POMERON CUTS IN INCLUSIVE REACTIONS, GRIBOV VERTICES, AND TOTAL CROSS-SECTION RISE. Kwiecinski, J. (Inst. of Nuclear Physics, Krakow); Okolowicz, J. Acta Phys. Pol.; B6: No. 1, 87-91(1975).

It has been found that the Gribov vertices (i.e. the fixed pole residue) which control the strengths of the two Pomeron cut contributions are very sensitive to details of the asymptotic form of the Pomeron-particle amplitude. Assuming that it is the two Pomeron cut which is responsible for an apparent lack of evidence for an effective triple Pomeron zero, an estimate of the Gribov vertices and their effect on the total pp cross section has been made. (auth)

1878 ISOMULTIPLET MASS DIFFERENCES. Isgur, N. (Univ. of Toronto). Can. J. Phys.; 53: No. 6, 574-580(15 Mar 1975).

A simple proposal is presented for understanding hadron isomultiplet mass differences as being the sum of two contributions: the elastic electromagnetic self energy and a part that may be visualized as a mass difference between the p and n quarks. The ensuing calculation, even in its crudest manifestation, leads to remarkable agreement with the observed pattern of mass differences in terms of a single parameter. (auth)

1879 NEW TRENDS IN MULTIPERIPHERAL DYNAMICS. Bassetto, A. (Univ., Padua). Acta Phys. Austr., Suppl.; No. 13, 5-56(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The lectures are confined to the study of the multiperipheral equations in the forward direction. The ABFST model is first examined; then the physical motivations and the ways to generalize it in a recently proposed formulation of multiperipheral dynamics are discussed. (LBS)

1880 PHENOMENOLOGY AND MODELS OF STRONG INTERACTIONS AT VERY HIGH ENERGIES. Frazer, W. R. (Univ. of California, San Diego, La Jolla). Acta Phys. Austr., Suppl.; No. 13, 57-116(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

Some of the observations made in high-energy multiparticle reactions at the ISR and at NAL in the past two years are reviewed. First, is the confirmation of the hypothesis of short-range correlations in rapidity from measurement of two-particle correlations at the ISR. The second observation is that of high-energy diffraction dissociation. From fits to multiplicity distributions from NAL, it was found from two-component models that the diffractive component is only about 20% of the inelastic cross section, whereas the short-range correlation component is about 80%. A second feature of diffractive dissociation, recently observed, is the existence of diffractive dissociation into large missing mass. The question of whether this rising diffractive cross section can account for the observed rising total cross section is discussed. (LBS)

1881 STATUS OF MESON–MESON INTERACTION. Petersen, J. L. (Nordita, Copenhagen). Acta Phys. Austr., Suppl.; No. 13, 291-359(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The current experimental situation for $\pi\pi \to \pi\pi$, $\pi\pi \to \kappa\bar{\kappa}$, and $\kappa\pi \to \kappa\pi$ phase shift analysis if briefly reviewed. An account is then given of some of the dispersion techniques which are evolving for the imposition of crossing symmetry. Results are presented of some analyses which have been carried out in order to complete the fragmentary picture provided by the phase shift analyses and to enable one to compare with theoretical models. (LBS)

1882 ASYMPTOTIC FREEDOM AND ALMOST-FREEDOM. Kummer, W. (Technische Hochschule, Vienna). Acta Phys. Austr., Suppl.; No. 13, 361-394(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The lecture dealing the nonabelian gauge models for strong interactions covers the following topics: scaling in deep inelastic lepton-hadron scattering; the Callan-Symanzik equation; and gauge fields for strong interactions. Some positive and negative features of gauge theories of strong interactions are summarized in the conclusions. (LBS)

1883 TWO-STEP DYNAMICAL PICTURE AND GENERALIZED THERMODYNAMICAL MODEL FOR MULTI-PARTICLE

PRODUCTION PROCESSES. Wesely, W. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 271: No. 3, 257-263(Dec 1974).

A general nonequilibrium formulation of quantum statistical mechanics allows for statistical as well as for dynamical features of a system. From the two-step dynamical model formulated in this frame, the diffractive production of a leading particle and secondaries deriving from the "evaporation" of a simultaneously produced fireball are discussed. (auth)

1884 AN INTRODUCTION TO THE THEORY OF DUAL MODELS AND STRINGS. Scherk, J. (Department of Physics, New York University, New York, N. Y. 10003). Rev. Mod. Phys. 47: No. 1, 123-163 (Jan 1975).

The theory of a free string is first presented classically and quantum mechanically both in a covariant and a nonexplicitly covariant treatment. Then the concepts and techniques obtained from the free string are used to build the operator formalism of dual models. Both the conventional Veneziano model and the Neveu-Schwarz-Ramond model are presented. The self-consistency of these models at the tree and loop levels is investigated, and the interpretation of the results obtained is given in terms of the string picture. (auth)

1885 ORBITAL EXCITATIONS IN CHARMONIUM. Harrington, B.J.; Park, S.Y.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 11, 706-707 (17 Mar 1975).

We use a linear potential to analyze the orbital excitations of a bound charmed quark-antiquark system. The model predicts that a 235-MeV γ ray should be emitted in the E1 transition from the 2^3S to be 1^3P_1 state. (auth)

1886 PRODUCTION OF HADRONS WITH LARGE TRANSVERSE MOMENTA IN THE FRAGMENTATION REGION. Shoikhet, V. Kh. (Tbilisi State University). JETP Lett. 20: No. 8, 268-270 (20 Oct 1974).

The inclusive cross section for the production of a hadron with large transverse momentum $p_\perp$ in the fragmentation region was obtained in the covariant parton model under the assumption that the hadron with large $p_\perp$ is the "decay product" of an isolated (in rapidity space) parton. Inclusive cross section characteristics that are typical of the given model and can be observed experimentally are noted. (auth)

Strong (Baryon No. = 0)

1887 (FRNC-TH-506) YANG-MILLS FIELDS AND PSEUDOSCALAR MESON SCATTERING. Zuber, J. B. (Paris-11 Univ., 91 – Orsay (France)). 1974. 95p. (In French). INIS.

A model for the pseudoscalar meson scattering (π,K,η) is studied. This model is based on a Lagrangian in which the mesons are coupled through massive Yang-Mills fields, identified with the physical (ρ,K*,φ) vector meson resonances. The calculation of the various two-body scattering amplitudes is performed, in perturbation, in the one loop approximation, and the Pade summation method is applied. As a result all the well known d wave resonances f_0, f', A_2 and K*(1420) are generated. No exotic states are found. The $\pi\pi$ and KK s waves phase shifts are in excellent agreement with experimental data; in particular the strong Kantik threshold effect in the $\pi\pi$ scattering can be reproduced. Very broad σ, κ, δ resonances are obtained. It is proved that the model, which is shown to be not renormalizable, is a limit of a renormalizable model containing Higgs-Kibble mesons which would lead to similar results. (FR)

1888 CHARM, EVDM AND NARROW RESONANCES IN e^+e^- ANNIHILATION. Dominguez, C. A. (Instituto Politecnico Nacional, Mexico City); Greco, M. Lett. Nuovo Cim.; 12: No. 12, 439-443(22 Mar 1975).

The consequences of the assumptions that in analogy with the normal vector mesons, the masses of the new narrow resonances obey a Veneziano-like spectrum and that scaling is reached at sufficiently high energies are worked out in complete analogy with standard EVDM. (JFP)

Strong (Baryon No. = 1)

Refer also to abstract 1794.

1889 (ANL/HEP/PR-75-06) CRITIQUE OF THE REGGEIZED DECK MODEL. Berger, E. L. (Argonne National Lab., Ill. (USA)). 1975. 91p. (CONF-750202-3). Dep. NTIS $7.75.

From conference on systems ecology; Logan, Utah, USA (20 Feb 1975).

A detailed analysis is presented of the Reggeized pion exchange Deck model for processes of the type ap yields A*N yields (a*pi)N, where a equals pi, K, or nucleon and a* equals rho, K*, N or DELTA. Predictions of the model for both production and decay properties of the low mass system A* yields (a*pi) are derived and contrasted with data. Diffractive as well as charge exchange reactions are treated. The role of pion exchange in generating (a*pi) enhancements near threshold and their properties is examined from several points of view. Characteristic exchange effects and quantum number properties (e.g., cross-overs) of the pion exchange Deck graph are shown to be verified in the data, but this graph alone is inadequate. The failures all point to the need for a second graph, having a* exchange properties. The contribution of a* exchange is roughly equal to that of the pi exchange graph. (auth)

1890 HOW WELL CAN THE CHEW-LOW THEORY REPRODUCE PION-NUCLEON SCATTERING? Bajaj, K. K.; Nogami, Y. (Department of Physics, McMaster University, Hamilton, Ontario, Canada L8S 4M1). Phys. Rev. Lett. 34: No. 11, 701-703 (17 Mar 1975).

When the Chew-Low theory for the πN interaction is used as a basis for studying the π-nucleus interaction, it is required to fit the free πN scattering data well. In this respect many calculations so far done are unsatisfactory. We show that an excellent fit is obtained within the existing Chew-Low framework if the inelasticity together with recoil and the crossing term are taken into account, and we comment on a recent work by Dover *et al.* (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 1848, 1934, and 2116.

1891 (DESY-74/53) SYNTHESIS OF THE NUCLEON–NUCLEON INTERACTION AT "LOW" AND "HIGH" ENERGIES. Schierholz, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1974. 13p. (AED-CONF-74-513-010). INIS.

From international conference on few body problems in nuclear and particle physics; Quebec City, Canada (27 Aug 1974).

Some concepts are presented as to how we might improve our understanding of the two-nucleon system and find a more convincing way of describing the nucleon-nucleon interaction at short distances and of handling the medium-range forces. (GE)

Particle Invariance Principles and Symmetries

General

1892 (AED-CONF-74-306-009) THE SEARCH FOR VIOLATION OF P OR T INVARIANCE IN ATOMS OR MOLECULES. Sandars, P. G. H. (Oxford Univ. (UK). Clarendon Lab.). 1974. 22p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

A discussion is given on the search for P and T violations in experiments which look for electric dipole moments and higher odd nuclear multipole moments. A discussion of Ramsey's work on the neutron is included because the methods used are very similar to those in atomic and molecular beam experiments. A number of proposed experiments which seem to have sufficient sensitivity to allow detection of the recently predicted weak P violating effects caused by neutral currents are discussed. (GE)

1893 (JINR-P2-8360) APPROXIMATE LORENTZ TRANSFORMATIONS ON THE FIRST AND SECOND ORDERS. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Time-like transformations of the first $(c^{-2})^0$ (Galilean transformations) and second (c^{-2}) orders are considered. It is emphasized that in the first approximation the formula for energy takes the form $E = mc^2$. Only in this case in a first approximation the relativistic formula for probability density can be reduced to $\rho = |\psi|^2$ whereas in the second approximation the relativistic expression should be used. It is shown that it is possible to get the known transformation formulas for probability density ($\rho' = \rho$) and position operator ($X' = X$) only based on space-like transformations of the first order. Criticism of ordinary procedure of obtaining the last formula by means of instantaneous Galilean transformations is given. A particular role of space-like transformations of the second order is indicated when the questions on invariant nonrelativistic equations of physics are under consideration. Attention is again given to incorrection of the usual proof of invariance of the Schrödinger equation relatively Galilean transformations. (auth)

1894 (JINR-P2-8493) GL(3,R) GROUP REPRESENTATIONS IN THE ROTATIONAL GROUP BASIS. Borisov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Unitary (infinite dimensional) representations of the linear transformation group in the three-dimensional space of GL(3,R) are studied using the induced representation method. Three sets of representations of this group are found in the discrete orthonormal basis of O(3) subgroup. Matrix elements of generators are presented, and irreducible representations are found inside each set. Equivalent representations are pointed out. (auth)

1895 IRREDUCIBLE REPRESENTATIONS OF SUPERSYMMETRY IN THE MASSIVE CASE. Grosser, D. (Univ., Tuebingen, Ger.). Lett. Nuovo Cim.; 12: No. 12, 455-458(22 Mar 1975).

In order to classify the elementary-particle states into multiplets one must find the irreducible representations of the supersymmetry algebra. A set of irreducible representations was previously constructed. It is shown that in the massive case this set contains all irreducible representations. (JFP)

Applications (Electromagnetic and Weak)

Refer also to abstract 1875.

1896 ψ PARTICLES, SU(4), AND ANOMALOUS CURRENTS. Das, T.; Divakaran, P.P.; Pandit, L.K.; Singh, V. (Tata Institute of Fundamental Research, Bombay, India). Phys. Rev. Lett. 34: No. 12, 770-773 (24 Mar 1975).

We propose assignment of the new ψ particles in an SU(4) symmetry scheme, incorporating SU(3) and a new additive quantum number, paracharge Z. Anomalous currents are introduced to account for the production and decays of these particles. Two more rather broad resonances at around 4.3 and 5.0($\pm$0.2)GeV are expected in the e^+e^- annihilation, one of which has recently been reported (at 4.15 GeV). (auth)

Applications (Strong)

1897 WIDTH OF ψ(3105). Kitakado, S.; Orito, S.; Walsh, T. F. (DESY, Hamburg). Lett. Nuovo Cim.; 12: No. 12, 436-438(22 Mar 1975).

A weakly broken nonet symmetry of the vector mesons is extended to SU(4) so as to include a new cc state ψ. From the masses one determines the mixing among ϕ, ω, ψ and thereby estimates $\Gamma(\psi \rightarrow \text{hadrons}) \approx 60$ keV. The significance of this is discussed for the case of a symmetry as badly broken as SU(4) must be if the new meson at 3.1 GeV is cc. (JFP)

Scattering Theory

1898 (JINR-P2-8340) PROOF OF THE S-MATRIX UNITARITY. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A formal proof of unitarity of the S-matrix is made by functional methods. The following statement is proved: if an intermediate regularization of the perturbation series is introduced via the propagators of virtual particles and if there exists a finite limit when the regularization is removed, then the limiting S-matrix is unitary. (auth)

1899 CORRECTIONS TO LINEAR TRAJECTORIES FROM DUAL LOOP AMPLITUDES. Karpf, A. D. (Freie Univ., Berlin). Acta Phys. Austr., Suppl.; No. 13, 665-677(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245--.

General pole series, asymptotic pole series, direct pole series and leading trajectory corrections are discussed. (LBS)

PHYSICS (LOW-TEMPERATURE)

Refer also to abstract 1834.

Superfluidity

Refer also to abstract 1917.

1900 FILM THINNING IN He II AT TEMPERATURES ABOVE 1.1 K. Flint, E.B.; Hallock, R.B. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. B 11: No. 5, 2062-2065 (1 Mar 1975).

We have made measurements of the velocity-dependent film thinning in saturated films of He II over the temperature range $1.1 < T < 1.6$ K using a new technique. Results from several experimental runs which employ different geometries in general show quantitative agreement with predictions based on the Bernoulli equation made by Kontorovich. The effects of fluid acceleration encountered in these measurements are considered and shown to be small. A recently proposed vapor-replenishment mechanism appears inconsistent with our observations. (auth)

1901 SOUND PROPAGATION IN SUPERFLUID ^{3}He NEAR THE POLYCRITICAL POINT. Roach, P.R.; Abraham, B.M.; Kuchnir, M. (Argonne National Laboratory, Argonne, Illinois 60439); Ketterson, J.B. Phys. Rev. Lett. 34: No. 12, 711-714 (24 Mar 1975).

We report studies of 20-MHz sound propagation in the *A* and *B* phases above the polycritical point, and in the *B* phase below the polycritical point. Some striking features are observed which were not seen heretofore. (auth)

1902 ANISOTROPY OF THE PROPAGATION OF SOUND IN THE *A* PHASE OF SUPERFLUID ^{3}He. Roach, P.R.; Abraham, B.M.; Roach, P.D. (Argonne National Laboratory, Argonne, Illinois 60439); Ketterson, J.B. Phys. Rev. Lett. 34: No. 12, 715-718 (24 Mar 1975).

We have studied the temperature dependence of the anisotropy of the attenuation and velocity shift of 20-MHz ultrasound propagating in the *A* phase of ^{3}He at a pressure of 26 bar and for magnetic fields less than 27 G. Measurements in the *B* phase at 21.0 bar show no anisotropy. (auth)

1903 EFFECT OF BOUNDARY CONDITIONS ON FINITE BOSE-EINSTEIN ASSEMBLIES. Greenspoon, S.; Pathria, R.K. (Department of Physics, University of Waterloo, Waterloo, Ontario, Canada). Phys. Rev. A 11: No. 3, 1080-1082 (Mar 1975).

The recent observation by Hasan and Goble of a discrepancy between their numerical results on the specific heat of an ideal Bose gas confined to a thin-film geometry and the earlier analytic calculations of Pathria employing Neumann boundary conditions is shown to be unjustified. In those cases where a true comparison is possible, e.g., under Dirichlet or periodic boundary conditions, the observed deviations turn out to be insignificant if one uses the more recent second-order calculations of Greenspoon and Pathria rather than the original first-order ones of Pathria. For comparison under Neumann boundary conditions, fresh numerical calculations are required. We also present here second-order analytic calculations of the specific heat of this system (i) under mixed boundary conditions (Dirichlet on one wall, Neumann on the other) and (ii) under antiperiodic boundary conditions, and compare them with the relevant numerical calculations of Hasan and Goble. (auth)

1904 PROPAGATION OF SOUND AND SECOND SOUND USING HEAT PULSES. Narayanamurti, V.; Dynes, R.C.; Andres, K. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 7, 2500-2524 (1 Apr 1975).

We present a detailed account of the transition from second sound to ballistic phonon flow in liquid He II as a function of temperature (0.1–1 K), pressure (up to the solidification point), and propagation length (~ 0.23–7.0 cm). Below 10 bar and 0.5 K, the phonon-phonon scattering time τ_{pp} has the form $\tau_{pp} \sim (7 \pm 3) \times 10^{-11}(T/\Theta)^{-3}$ sec, where Θ is the low-temperature Debye temperature. Above 10 bar, $v\tau_{pp} > 2$ cm for $T \lesssim 0.7$ K, where v is the sound velocity. The strong pressure dependence of τ_{pp} is qualitatively consistent with the theoretical model of Jäckle and Kehr. The phonon-roton scattering time τ_{pr} is found to be nearly pressure independent and has a value ~ 10^{-6} sec at ~ 0.75 K in agreement with the calculations of Khalatnikov and Chernikova. Evidence for separate roton second sound (at high pressures) and phonon second sound at SVP is presented. An elementary excitation picture of second sound in the entire gas of excitations in He II is presented and the close analogy with phonon second sound in solids (bismuth) and in a gas of particles (He^4) is experimentally illustrated. Estimates for the number of collisions required for the formation of the collective mode from the single-particle-like excitations are given. (auth)

1905 EFFECTS OF CRYSTALLINE SUBSTRATE POTENTIALS ON QUASI-TWO-DIMENSIONAL LIQUID HELIUM. Novaco, A.D. (Brookhaven National Laboratory, Upton, New York 11973 and Department of Physics, Lafayette College, Easton, Pennsylvania 18042); Campbell, C.E. Phys. Rev. B 11: No. 7, 2525-2534 (1 Apr 1975).

The effects of a finite substrate-helium interaction and of the crystalline structure of a substrate potential on the liquid phase of a monolayer of helium are explored for models of three systems: helium physisorbed on a basal-plane surface of graphite; ^{4}He adsorbed on graphite preplated by a close-packed layer of neon; and ^{4}He adsorbed on graphite preplated by a close-packed layer of argon. The ground-state energy as a function of the areal density is calculated for each of these models by introducing a class of trial wave functions which have finite extent orthogonal to the substrate, possess the same translational symmetry as the substrate, and include short-range correlations between the helium atoms. The results for ^{4}He on bare graphite are virtually identical with previous results for the model of ^{4}He atoms in a two-dimensional structureless box, with very small quantitative differences. The indications for ^{3}He on bare graphite are that the liquid is not self-bound. In contrast to the bare-graphite substrate, the other two substrates exert a strong influence on the liquid, substantially increasing the equilibrium density. (auth)

1906 MAGNETIC RESONANCE AND SPIN WAVES IN THE *A* PHASE OF SUPERFLUID ^{3}He. Maki, K. (Department of Physics, University of Southern California, Los Angeles, California 90007); Tsuneto, T. Phys. Rev. B 11: No. 7, 2539-2543 (1 Apr 1975).

Extending an idea due to Leggett, that the longitudinal resonance in the *A* phase of superfluid ^{3}He is considered as an internal Josephson effect, we discuss the nuclear magnetic resonance as well as spin waves in the *A* phase of superfluid ^{3}He. The spin-wave dispersion in the hydrodynamic regime is determined explicitly. (auth)

1907 KAPITZA CONDUCTANCE, TEMPERATURE GRADIENTS, AND SOLUTIONS TO THE BOLTZMANN EQUATION. Saslow, W.M. (Department of Physics, Texas A&M University, College Station, Texas 77840). Phys. Rev. B 11: No. 7, 2544-2551 (1 Apr 1975).

In the belief that the study of heat transport requires the study of the transport equation, we present an approach to the problem of the Kapitza conductance h_K between two materials which involves the solutions of the Boltzmann equation. One of our purposes is to investigate the origin of the apparent temperature discontinuity ΔT that is associated with this phenomenon. The hydrodynamic solutions of the Boltzmann equation, which (by definition) are describable in terms of local thermohydrodynamic variables, can transfer heat but are not at all responsible for ΔT; whereas the nonhydrodynamic solutions are completely responsible for ΔT but do not transfer heat. An effective temperature $\bar{T}$ is defined which approaches the thermodynamic temperature T far from the interface, and which is assumed to be continuous across the interface. With this assumption, formal expressions for ΔT and h_K are derived. In the limit as the properties of the two materials become identical, R_K $(=h_K^{-1})$ approaches zero, as should be the case. Further, this approach has a natural generalization to finite frequencies and includes lifetime effects. It is pointed out that thermometers do not measure $\bar{T}$ but rather T_R which reflects, in a complicated fashion, the presence of the nonhydrodynamic modes, whose amplitudes fall off exponentially as one moves from the interface. In He II, determination of the exponential damping lengths (as a function of temperature and pressure) would provide information about phonon dispersion and phonon interactions which is at least as detailed as could be obtained by other means. (auth)

1908 COMMENT ON "SEARCH FOR THE AC JOSEPHSON EFFECT IN LIQUID HE". Anderson, P.W. (Bell Laboratories, Murray Hill, New Jersey 07974); Richards, P.L. Phys. Rev. B 11: No. 7, 2702-2704 (1 Apr 1975).

It has been recently suggested that all experiments which have attempted to show the analog of the ac Josephson effect in superfluid helium can be explained more plausibly by the presence of acoustic resonances in the apparatus. In this addendum we point out that the original experiment by Richards and Anderson differs from all succeeding experiments in such a way that the explanation of it in terms of acoustic resonances is much more difficult. (auth)

1909 VISCOSITY AND THERMAL CONDUCTIVITY OF SUPERFLUID ^{3}He: LOW-TEMPERATURE LIMIT. Pethick, C.J. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801); Smith, H.; Bhattacharyya, P. Phys. Rev. Lett. 34: No. 11, 643-646 (17 Mar 1975).

We calculate the viscosity ν and diffusive thermal conductivity κ_D of the Balian-Werthamer state of a p-wave superfluid for $T<T_c$. The nature of the excitations in the superfluid state is fully taken into account, and realistic effective interactions are used. η tends to a constant, $\sim 1/4\eta$ (T_c) for liquid ^{3}He, and $\kappa_D \sim T^{-1}$. Mean free paths are also calculated. (auth)

1910 NUCLEAR SUSCEPTIBILITY OF SUPERFLUID B-^{3}He. Corruccini, L.R. (Department of Physics, University of California at Davis, Davis, California 95616); Osheroff, D.D. Phys. Rev. Lett. 34: No. 11, 695-697 (17 Mar 1975).

We have measured the reduced susceptibility of superfluid B-^{3}He using pulsed NMR techniques at melting pressures. These measurements, which extend from $T/T_c=0.77$ to $T/T_c=0.39$, support the continuous-wave NMR results of Osheroff. Values of ρ_s/ρ deduced from these susceptibility values are shown to agree well with fourth-sound measurements of ρ_s/ρ and theoretical calculations. From these agreements we conclude that B-^{3}He is well described by existing theory to quite low temperatures. (auth)

1911 SELF-CONSISTENT CALCULATION OF THE THERMODYNAMIC POTENTIAL FOR SUPERFLUID STATES IN ^{3}He NEAR T_c. Tewordt, L.; Fay, D.; Dörre, P.; Einzel, D. (Abteilung für Theoretische Festkörperphysik, University of Hamburg, West Germany). Phys. Rev. B 11: No. 5, 1914-1923 (1 Mar 1975).

A self-consistent diagram technique is developed in terms of a 4×4 Green's function and a symmetrized $4\times4\times4\times4$ interaction vertex to investigate the effect of spin fluctuations on the self-energy and thermodynamic potential in superfluid ^{3}He. In addition to reproducing the results of Brinkman, Serene, and Anderson (BSA), the resulting T-matrix approximation leads to the appearance of a new class of anomalous diagrams not considered by BSA. These new contributions involve a coupling of the particle-particle and particle-hole channels and give rise to an effective paramagnetic enhancement of the particle-particle T matrix below T_c. They are shown to further increase the stability of the Anderson-Morel state relative to that of the Balian-Werthamer state near T_c. Results are stated in terms of the five fourth-order invariants. The specific-heat discontinuity is calculated and discussed in the context of recent experimental results. (auth)

1912 THE EFFECT OF AN ELECTRIC FIELD ON SUPERFLUID HELIUM 3. Delrieu, J. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris), Lett.; 35: No. 10, L.189-L.192 (Oct 1974). (In French).

An electric field can produce a single domain in the A-phase of superfluid helium 3 and, because of its small effect in the B phase, test the orbital isotropy of the B phase. (FR)

1913 HYDRODYNAMICS OF AN ANISOTROPIC SUPERFLUID. Viscosity and Thermal Conductivity of the A Phase of Helium 3. Seiden, J. (Paris-11 Univ., 91 - Orsay (France). Inst. d'Electronique Fondamentale). Compt. Rend., Ser. A, B; 279: No. 7, 151-154 (12 Aug 1974). (In French).

The shapes of the thermal conductivity and viscosity tensors of the A phase of superfluid ^{3}He were determined. The A phase is considered to have a cylindrical symmetry. (FR)

Superconductivity

Refer also to abstracts 532–537, 589–591, 593, 1388, 1389, 1443, 1472, 1474, 1475, 1479–1482, 1485, and 1486.

1914 THE TRANSITION TEMPERATURE OF SUPERCONDUCTORS. Hertel, P. Saarbruecken, Ger.; Univ. des Saarlandes (1971). 87p. (In German). INIS.

Thesis.

A new iterative method for the determination of the transition temperature, which leads to an exact conditional equation for T_c, is presented. It is shown that there is little hope to reach transition temperatures above 20°K for superconductors whose transition temperature is determined by phonon mechanisms. (GE)

1915 CURRENT PROBLEMS OF SUPERCONDUCTIVITY. Buckel, W. (Univ., Karlsruhe, Ger.). pp 263-281 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German)

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

A brief review is given of the development of experimental and theoretical data on superconductivity. Problems connected with the search for materials with a high T_c and for materials with a high critical magnetic field are summarized. Experimental studies on the measurement of superconductivity and phenomena connected with it are described. (JSR)

1916 HERBSTSCHULE UEBER ANWENDUNG DER SUPRALEITUNG IN ELEKTROTECHNIK UND HOCHENERGIEPHYSIK. (Autumn School on the Application of Superconductivity in Electrotechniques and High Energy Physics). Karlsruhe, F. R. Germany; GfK (1972). vp. (In English and German).

From autumn school on the application of superconductivity in electrotechniques and high energy physics; Titisee (F. R. Germany) (9 Oct 1972).

The texts of 23 specialist lectures are given on the fundamentals of superconductivity and cryogenics; on the physics of super fluid helium, helium heat transfer, the physics of hard superconductors, development of hard superconductors (example Nb–Ti); on superconductivity in the microwave region, high-frequency systems and components, effect in real high-frequency cavities, the application of superconducting resonators and magnometers (in the measuring technique), d.c. magnets, superconducting pulse magnets, superconducting magnets in accelerators, the Josephson effect in electrical measuring technique, electrical machines with superconductors, electromagnetic suspension systems with superconductors for high-speed railways, cryoplants, superconducting cables, a superconducting high-power three-phase cable, cable technical problems in the projecting and constructing of transmission sections with superconductors and on a superconducting equipment for energy storage. (GE)

1917 EVALUATION OF LATTICE SUMS FOR CLEAN TYPE-II SUPERCONDUCTORS. Fetter, A.L. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. B 11: No. 5, 2049-2052 (1 Mar 1975).

A simplified treatment is presented for the lattice sums occurring in the theory of clean extreme type-II superconductors, rotating superfluid helium, and plasma oscillations in an array of filamentary conductors. Similar methods are applied to the mixed state of a thin superconducting film in a perpendicular magnetic field. (auth)

1918 STRONG-COUPLING THEORY FOR DISORDERED SUPERCONDUCTORS. Takayama, H. (Institut Max von Laue-Paul Langevin, 38 - Grenoble (France)). J. Phys. (Paris), Colloq.; No. 4, 299-300 (May 1974).

From colloquium on disordered metallic systems; Strasbourg, France (10 Sep 1973).

The electron-phonon interaction in a disordered metal was studied, emphasis being given to the problem of how the lack of a translational symmetry affects characteristic features of the interaction. In the superconducting state the effect gives rise to modifications of the Eliashberg equation, which is a basic equation in the strong-coupling theory of superconductivity. (FR)

PHYSICS (NUCLEAR)

Refer also to abstract 1834.

Neutron Interactions with Matter

Refer also to abstract 2110.

1919 (UCID-16725, pp 7-8) ^{238}U PULSED SPHERE MEASUREMENTS AND CTR FUSION–FISSION BLANKET CALCULATIONS. Wong, C.; Anderson, J. D.; Haight, R. C.; Hansen, L. F.; Komoto, T. 11 Mar 1975.
In status report to USNDC.

1920 ESCAPE PROBABILITIES FROM COAXIAL CYLINDERS. Ozmutlu, C.; Birsen, N. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 2: No. 1, 14-18 (Feb 1975).
The escape probabilities from cylinders which contain hollow or different materials in the central region, have been calculated by modifying Sauer's method [Nucl. Sci. Eng., 16, 329 (1963)]. For the value of $\Sigma\bar{l}$ its volume-weighted average value is introduced; that is, the system is assumed to be homogeneous. The calculations are carried out for different values of $(\Sigma\bar{l})_{eff}$. (auth)

1921 CALCULATION OF THE FUNDAMENTAL MODE OF THE ONE VELOCITY NEUTRON TRANSPORT OPERATOR. Rangaswamy, L.; Ahmed, F. (Univ. of Delhi). Can. J. Phys.; 53: No. 5, 555-557(1 Mar 1975).
We report here the P_1 and P_3 solutions (eigenvalues and eigenfunctions) for the case of one velocity pulsed slabs. (auth)

1922 PRODUCTION AND USES OF ULTRACOLD NEUTRONS. Steyerl, A. (Technische Universitaet, Munich). pp 86-106 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German)
From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).
The experimental studies made in the last six years on cold neutrons ($E < 10^{-4}$ eV) are briefly summarized. The use of vertical radiation tubes and neutron sources in their production is discussed. The use of ultracold neutrons in the study of nuclear capture cross sections, submicroscopic structures in solids, and thin layers is described. A neutron storage device is described. Additional experimentals planned with cold neutrons in solid state physics and the study of neutron properties are outlined. (JSR)

1923 ASSESSMENT AND MODIFICATION OF NEUTRON CROSS SECTIONS VIA INTERACTIVE GRAPHICS. Danchak, M. Troy, NY; Rensselaer Polytechnic Inst. (1974). 264p. University Microfilms Order No. 75-5382.
Thesis (Ph. D.).
A unique interactive graphics analysis system, RIGAS, was devised to allow a user to calculate, display, compare, manipulate, and modify his data without requiring any programming expertise on the part of that user. This was accomplished by establishing human primacy, through extensive human factor considerations, and designing a man–machine dialog. This system resulted in an instrument which maximizes man's decision-making capability and the computer's speed to improve graphic communications and bring data analysis to a point commensurate with twentieth century technology. RIGAS was applied to neutron cross section assessment and modification, using continuous slowing-down theory, to provide a technique which was previously considered feasible but impractical. The slowing-down parameters XI and Age were visually and interactively iterated and coupled with an on-line flux calculation to allow real-time matching of experimental and theoretical neutron spectra. The resulting slowing-down parameters then reflected areas of discrepancy in cross section sets and provided a basis from which recommendations for changes in these sets could b e made. The resulting tool conservatively decreased analysis time by a factor of 80 and produced initial recommendations for changes to the cross section sets of depleted uranium and iron. It was found that ENDF/B-II overestimated the effects of inelastic scattering in the keV region for depleted uranium and requires modification of the secondary distributions. The self-shielded capture cross sections in the 10 to 40 keV region also require reduction. The Iron-1124 data set was likewise determined to have too strong a contribution from scattering in the high-keV–low-MeV region. (Diss. Abstr. Int., B)

1924 SOLUTION OF THE SLOWING DOWN EQUATION IN THE PRESENCE OF INELASTIC SCATTERING. El-Wakil, S. A.; Saad, E. A. (Atomic Energy Establishment, Cairo (Egypt). Reactor Dept., Atomic Energy Establishment, Cairo (Egypt). Reactor and Neutron Physics Dept.). Atomkernenergie; 24: No. 4, 276-278(1974).
The slowing down equation is solved in the presence of inelastic scattering by Riesz-method. The contribution of the excited states is expressible in terms of the Green function of only elastic scattering and a parameter which depends on the choice of a trail function. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 1642, 1644, 1843, 1861, 1944, 2039, 2108, and 2119.

1925 (COO-1779-155, pp 48-49) PRODUCTION OF ^{7}Li IN THE $\alpha + \alpha$ REACTION. King, C. H.; Rossner, H. H.; Chien, W. S.; Austin, S. M. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1926 NUCLEAR SPECTROSCOPY WITH He4. Kankowsky, R. Erlangen, Ger.; Univ. Erlangen-Nuernberg (1972). 66p. (In German). INIS.
Thesis.
Nuclear spectroscopy in ^{4}He is considered. Investigations of the reactions ^{2}H(d,d)^{2}H, ^{2}H(d,p)^{3}H, and ^{2}H(d,n)^{3}He in the energy range from 3.5 to 10 MeV are reported. The analyzing power of the three reactions was measured simultaneously by means of the vector-polarized deuteron beam of the Erlangen tandem accelerator. The mirror reactions ^{2}H(d,p)^{3}H and ^{2}H(d,n)^{3}He show the same angular distributions of analyzing power. Very low analyzing power was observed at all energies for elastic scattering. Both results are in good agreement with the known behavior of these reactions at higher energies ($E_{d,\,lab} \geq 10$ MeV). A scattering phase analysis of the elastic p-^{3}H scattering was presented in the range of $E_{lab} = 4.15$ to 12.0 MeV. The analysis was carried out using values for the differential cross section and analyzing power determined by earlier measurements with the polarized proton beam at the Erlangen accelerator. The results of the analysis compare satisfactorily with the level scheme in ^{4}He and are indicative of a 2^{+}-resonance near the d + ^{3}H-threshold. (orig./CB)

1927 ANALYSIS OF THE LEVEL STRUCTURE IN ^{5}Li USING THE THREE-PARTICLE-REACTION D + ^{3}He → p + t + p. Schroeder, H. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). 9 Jul 1973. 66p. (In German). INIS.
With figs. and tabs.; 53 refs. Available from the library of the Freiburg Univ.
The primary interaction of the composite reaction via the ^{4}He*(0^{+})-state produces a compound nucleus ^{5}Li* at $E(^{5}Li^{*}) = (18.9 \pm 0.2)$ MeV with a level width of (1.5 ± 0.2) MeV, produced via the reaction D + ^{3}He → ^{5}Li*($3/2^{-}$) → p + ^{4}He*(0^{+}) → p + t + p. (GE)

1928 THE REACTION ^{3}He(d,p)^{4}He WITH A POLARIZED TARGET. Beckmann, R.; Holm, U.; Lorenzen, K. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Experimentalphysik). Z. Phys.; 271: No. 2, 89-91(Dec 1974).
The left-right asymmetry for the ^{3}He(d,p)^{4}He reaction has been measured with a polarized ^{3}He target at a bombarding energy of 12 MeV. The experimental results are compared with proton polarization measurements for unpolarized target and beam. The construction of the optically pumped ^{3}He target is described. A special design has been chosen to overcome the difficulty that the target contamination caused by the bombarding particles destroys the polarization. The target can easily be purified without removing it from the experimental set-up. (auth)

1929 RESONANCE REACTIONS: ISOBARIC ANALOG STUDIES IN LIGHT NUCLEI (A less than 65). Temmer, G. M. (Rutgers-The State Univ., New Brunswick, NJ). pp 61-87 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).
The essential features of the isospin formalism are summarized. Formation of proton induced compound nuclear resonances whose isospin values exceed those of the ground state of the nucleus (A + 1, Z + 1) by 1 or 2 is briefly discussed. Isospin-allowed and isospin-forbidden analog resonances in light nuclei are examined. Remarks are made on what can be learned quantitatively concern-

ing isospin impurities in lighter nuclei from observations of isospin-forbidden resonances. (22 figures, 90 references) (SDF)

1930 BOUND TRINUCLEON SYSTEM USING A ONE-BOSON-EXCHANGE POTENTIAL. Harper, E. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. Lett. 34: No. 11, 677-680 (17 Mar 1975).

The relativistic one-boson-exchange potential of Holinde, Erkelenz, and Alzetta is used to calculate the ^{3}He binding energy (E_3), wave function, and charge form factor. The calculation uses the $^1S_0$ and $^3(S-D)_1$ two-nucleon states and all the three-nucleon states that can then occur. The binding energy was found to be 6.75 MeV; the wave function composition was P(S) = 92.8, P(S') = 1.6, and P(D) = 5.7; and the form factor had a diffraction minimum at $Q^2=16.8$ fm^{-2} and a secondary maximum of strength 5.8×10^{-4} at $Q^2=22.8$ fm^{-2}. (auth)

1931 SEPARABLE-PAIR METHOD CALCULATION USING MORSE POTENTIALS. Goss, D. (Nebraska Wesleyan University, Lincoln, Nebraska 68504). Phys. Rev. C 11: No. 3, 1054-1055 (Mar 1975).

A schematic separable-pair calculation using Morse potentials gives improved values for internal pair energies (e.g. no ^{4}He bound state, ^{6}Li excited states in close agreement with experiment). The mean square nuclear radius is related to the mean square nucleon separations as well as the external (pair c.m.) mean square radii; this provides the constraint on the external kinetic energy, which in principle allows the structure of a nucleus to be determined from the nucleon-nucleon potential. A calculation of nuclear radii from experimental binding energies and internal radii renormalized to a neutron-proton separation of 3.7 fm yields radii in qualitative agreement with experiment and provides a test of the "realism" of the potential used. (auth)

1932 OBSERVATION OF TWO-PHOTON DECAY IN *n-p* CAPTURE. Dress, W.B. (Institute Laue-Langevin, Grenoble, France); Guet, C.; Perrin, P.; Miller, P.D. Phys. Rev. Lett. 34: No. 12, 752-755 (24 Mar 1975).

Coincident γ rays of total energy 2.22 MeV, the deuteron binding energy, were observed following the capture of subthermal neutrons by an H_2O target. The differential cross section, assuming a 1/v neutron energy dependence, increases from about 0.2 μb/keV at equal γ energies to about 1.0 μb/keV for a γ energy of 1600 keV. The branching ratio for emission of two γ rays, both in the γ-ray energy range from 600 to 1620 keV, to single 2.22-MeV γ rays was found to be $(1.05\pm0.16)\times10^{-3}$. (auth)

1933 ELECTRODISINTEGRATION OF ^{3}He. Skopik, D.M.; Murphy, J.J. II; Shin, Y.M.; Chong, K.F.; Tomusiak, E.L. (Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, Canada S7N 0W0). Phys. Rev. C 11: No. 3, 693-699 (Mar 1975).

An experimental study of the reaction ^{3}He(e, d) ep was carried out by measuring differential cross sections of deuterons as a function of deuteron energy and angle for three incident electron energies. The electrodisintegration cross section was also calculated using an Irving-Gunn wave function for the ground state with a plane wave for the final state. As in the case of photodisintegration calculations the result indicates the need for including complete final-state rescattering effects. (auth)

1934 OFF-SHELL LENGTH FOR THE TWO-NUCLEON T MATRIX IN THE $^3S_1$-$^3D_1$ STATE. Fuda, M.G. (Natuurkundig Laboratorium der Vrije Universiteit, Amsterdam, The Netherlands). Phys. Rev. C 11: No. 3, 664-667 (Mar 1975).

It is shown that the off-shell behavior of the low-energy, two-nucleon T matrix, in the coupled $^3S_1$-$^3D_1$ state, can be characterized by a single parameter, which is the generalization from central to noncentral forces of the equivalent or off-shell length. An approximate linear relation between the square of the off-shell length and the intrinsic range, which holds for central forces, is shown to be also valid for noncentral forces. It is found that the approximate relation is exact for a separable potential of the Yamaguchi type, and hence, for the unitary pole approximation. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 1838, 1843, 1849, 1929, 1931, 1973, 1977, 2039, 2090, 2108, and 2122.

1935 (COO-1779-155, p 4) SECOND MASS QUARTET IN A = 9 NUCLEI. Benenson, W.; Kashy, E. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1936 (COO-1779-155, p 5) MASS OF ^{9}Li. Kashy, E. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1937 (COO-1779-155, pp 8-9) MASS OF ^{12}N. Nolen, J.; Cantino, M.; Calaprice, F. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1938 (UCID-16725, pp 8-9) CROSS SECTION FOR THE ^{9}Be(n,t$_1$)^{7}Li REACTION FOR E/sub n/(LAB) BETWEEN 13.3 AND 15 MeV. Dietrich, F. S.; Hansen, L. F.; Koopman, R. P. 11 Mar 1975.
In status report to USNDC.

1939 CONFIGURATION MIXING AND THE GAMOW–TELLER MIRROR ASYMMETRY IN MASS 12 AND MASS 13. Greenland, P. T. (Univ. of Manchester, Eng.). J. Phys. G, Nucl. Phys.; 1: No. 1, 1-16(10 Jan 1975).

By using the Cornell nuclear interaction the value of the asymmetry in mirror Gamow–Teller decay ft values which stems from the Coulomb interaction is calculated. The mass 12 and mass 13 systems are considered. The optimum values of the asymmetry $\delta = (ft)^+/(ft) - 1$ which arise from the Coulomb interaction are found to be $\delta = 0.112 \pm 0.027$ for mass 12 and $\delta = 0.119 \pm 0.02$ for mass 13, with upper limits of 0.148 ± 0.004 and 0.166 ± 0.007. These compare favorably with the experimental values of 0.115 ± 0.009 for mass 12 and 0.166 ± 0.026 for mass 13. Including the lack of mirror symmetry between ^{13}N and ^{13}C brings the optimum value for mass 13 to $\delta = 0.148$ with an upper limit of 0.195 ± 0.017. It is concluded that the Coulomb interaction is sufficient to account for the observed asymmetry in both systems. (auth)

1940 STUDY OF ^{14}N(α,d)^{16}O REACTION AT 21 MeV. Turkiewicz, I. M. (Inst. of Nuclear Research, Warsaw); Delaunay, J.; Fouan, J. P. Acta Phys. Pol.; B6: No. 1, 123-127(1975).

Angular distributions of deuterons from the ^{14}N(α,d)^{16}O reaction were measured. The analysis was made in terms of two-nucleon stripping DWBA theory using shell model wave functions of initial and final nuclei. (auth)

1941 STUDY OF THE STRUCTURE OF PARTICLE NON-STABLE STATES. Hagen, M. Berlin; Freie Univ. (1970). 57p. (In German). INIS.
Thesis.

By means of two-nucleon transfer reactions on the target nucleus ^{10}B, states in the ^{12}C and ^{12}N were excited at excitation energies between 20 and 27 MeV or between 0 and 9 MeV. The transitions to levels at 20.5 MeV in ^{12}C and at 5.3 MeV in ^{12}N showed here a very large cross section relative to one another. By means of DWBA analyses of their angular distributions and from angular correlations from coincidence measurements, the spin could be clearly determined to be 3^+. They form together an isobar triplet with a level at 5.61 MeV in ^{12}B. Furthermore, the branching of a few ^{12}C levels on different decay channels and to different end states were measured in kinematically complete coincidence experiments. Finally, a few new levels in ^{12}N and its proton decay branching into different ^{11}C-states were also observed. (GE)

1942 HEAVY ION REACTIONS ON P AND S–D SHELL NUCLEI. Zeller, A. F. Tallahassee, FL; Florida State Univ. (1974). 154p. University Microfilms Order No. 75-7312.
Thesis (Ph. D.).

The reactions of ^{14}N on ^{12}C and Si; ^{16}O on C, Mg, and ^{27}Al; and ^{19}F on ^{12}C and ^{13}C were studied at bombarding energies of 16 to 75 MeV. Reaction products were counted off-line with a Ge(Li) detector and identified by their gamma-ray energies and half-lives. Yields of products that were only a few nucleons or alpha particles removed from the compound nucleus mass were compared with those calculated from Hauser–Feshbach theory and Weisskopf–Ewing theory. It was shown that they were produced by evaporation from a compound nucleus. In general, the use of the rigid-body moment of inertia gave yields that were too high, while I equals 1/2I/sub rig/ gave reasonable fits to the data. Yields of reaction products that were very far removed have the compound nucleus, like ^{7}Be, could not be fit either by evaporation theory or by fission theory. This, and a correlation between yield and mass of the projectile, indicate a probable quasi-direct or quasi-molecular reaction. (Diss. Abstr. Int., B)

1943 KINEMATICAL PECULIARITIES OF ENDOTHERMIC THREE PARTICLE REACTIONS. Kamke, D. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Z. Phys.; 271: No. 4, 367-375(Dec 1974). (In German).

Endothermic three-particle reactions have certain kinematical peculiarities. Equivalent situations are duplicated if the velocity of the center of mass is greater than the velocities of subsystems. As an example the reaction ^{7}Li(α,t)2α (Q = –2.466 MeV) is discussed. (auth)

1944 RESONANCE REACTIONS: CROSS-SECTION AND POLARIZATION STUDIES OF LIGHT NUCLEI. Bacher, A. D. (Indiana Univ., Bloomington). pp 3-60 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).

Background for experimental techniques useful in cross section and polarization measurements is discussed along with the analysis and interpretation of results. Applications of these techniques to specific spin systems, namely $0+0$, $\frac{1}{2}+0$, $1+0$, and $\frac{1}{2}+\frac{1}{2}$ are given. A brief examination of reaction studies of compound nuclei is given in which results obtained for compound levels in ^{9}Be are compared with a recent analysis of alpha-alpha elastic scattering measurements. High lying level structure of ^{5}Li is also briefly discussed. (21 figures, 103 references) (SDF)

1945 *E*1 TRANSITIONS IN ^{17}F. I. THE LOW-LYING $T = 3/2$ STATES. Harakeh, M.N.; Paul, P.; Snover, K.A. (Department of Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. C 11: No. 3, 998-1007 (Mar 1975).

The ^{16}O$(p, \gamma_{0,1})^{17}$F reaction was studied in the region of previously reported low-lying $T = 3/2$ states in ^{17}F. Resonances were observed at $E_p = 11.275 \pm 0.006$, 12.711 ± 0.006, 13.255 ± 0.006, 14.435 ± 0.010, and 14.583 ± 0.006 MeV with $(2J_R + 1)\times$ $\Gamma_{p_0}\Gamma_\gamma/\Gamma = 1.2 \pm 0.4$, 13.6 ± 3.5, 2.5 ± 1.5, 13.0 ± 5.9, and 11.8 ± 5.3 eV, respectively. Using reported values for $(2J_R + 1)\ \Gamma_{p_0}/\Gamma$, radiative widths $\Gamma_\gamma = 6.0 \pm 2.5$, 11.3 ± 3.4, 2.8 ± 1.8, 81 ± 54, and 13.4 ± 7.0 eV were deduced for the respective resonances. Shell model 2p-1h calculations using realistic Kuo-Brown interaction matrix elements were performed. The computed excitation energies and B ($E1$) values were found to agree with the experimental results. (auth)

1946 *E*1 TRANSITIONS IN ^{17}F. II. THE REGION OF THE GIANT RESONANCES. Harakeh, M.N.; Paul, P. (Department of Physics, State University of New York, Stony Brook, New York 11794); Gorodetzky, Ph. Phys. Rev. C. 11: No. 3, 1008-1014 (Mar 1975).

The giant dipole resonance of ^{17}F was studied by radiative proton capture. An observed integrated strength of 10 MeV mb, presumably mostly $T = 1/2$, is centered at 22 MeV with a width of ~ 5 MeV. Calculations were performed for odd-parity 2p-1h, 1p excitations in a basis of good isospin. These calculations predict correctly the observed strength distribution. Some general rules for the T components of the $E1$ collective state are consistent with the microscopic calculation. The $f_{7/2} \rightarrow d_{5/2}$ strength was located near 18 MeV, in agreement with other experimental evidence. (auth)

1947 SPECTRA OF PROTONS EMITTED IN THE BACK HEMISPHERE UPON DISINTEGRATION OF C^{12} BY 3.7 GeV/c π^- MESONS. Aref'ev, A.V.; Bayukov, Yu. D.; Gavrilov, V.B.; Efremenko, V.I.; Zaitsev, Yu. M.; Leksin, G.A.; Suchkov, D.A. (Institute of Theoretical and Experimental Physics). JETP Lett. 20: No. 8, 267-268 (20 Oct 1974).

We measured the spectrum of the protons emitted backward in the laboratory frame upon disintegration of the C^{12} nucleus; the spectrum is adequately described by an exponential relation of the type A $\exp(-Bp^2)$. The slope parameter coincides within the limits of errors with the value of B obtained from the spectra of the protons emitted backward in other processes. (auth)

1948 DETERMINATION OF THE ^{12}C + p RESONANCE ENERGY AT 14.2 MeV. Goss, J.D.; Browne, C.P.; Rollefson, A.A.; Jolivette, P.L. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 11: No. 3, 710-714 (Mar 1975).

The ^{12}C + p resonance energy of the lowest $T = 3/2$ state in ^{13}N has been determined by using the 100 cm broad-range magnetic spectrograph to measure the incident proton beam energy and a solid state detector to measure the ^{12}C$(p, p)^{12}$C yield curve. Phase-shift analyses of 10 proton elastic scattering yield curves taken at a laboratory observation angle of 160° give a value of the ^{12}C + p resonance energy of 14.2325 ± 0.0022 MeV. We compare our result with that of a recent time-of-flight measurement ($14.230\,75 \pm 0.000\,20$ MeV) and conclude that the nuclear-reaction energy scale based on the ^{210}Po(α) energy is in agreement with the absolute measurement against the meter and second to within an uncertainty of better than 0.016%. (auth)

1949 ^{16,18}O$(\alpha, ^{6}$He$)^{14,16}$O REACTIONS. VanderMolen, A.; Becchetti, F.D.; Jänecke, J.; Chua, L. (Cyclotron Laboratory, Department of Physics, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. C 11: No. 3, 734-737 (Mar 1975).

The (α, ^{6}He) reaction on ^{16}O and ^{18}O has been studied at $E_\alpha = 58$ MeV. Although the cross sections are much smaller than the corresponding (p, t) cross sections by about a factor of 20, the angular distributions are characteristic of a direct transfer mechanism and are reproduced satisfactorily by distorted-wave theory assuming LS coupling in ^{6}He. (auth)

1950 PHENOMENOLOGICAL ABSORPTION MODEL FOR PION-NUCLEUS SCATTERING. Kazaks, P.A.; Smith, J.A. (New College, Sarasota, Florida 33578). Phys. Rev. C 11: No. 3, 715-718 (Mar 1975).

A phenomenological model is used to obtain cross sections for 120–230 MeV pions elastically scattered from ^{12}C. The model wave function consists of a diffuse hole cut out of a plane wave and a focus term. Three parameters in the focus term are varied to fit the experimental cross sections. The focus is found to be essential but diminishing in strength up to 200 MeV. It then becomes very weak. Good fits are obtained with this very simple procedure. It can be used to readily obtain the simplest kind of distorted pion wave. (auth)

1951 QUASIFREE SCATTERING ON CLUSTERING PARTICLES AND SEPARATION ENERGIES. Sakamoto, Y. (Institut für Kernphysik der Universität Frankfurt am Main, Germany); Cüer, P.; Takéutchi, F. Phys. Rev. C 11: No. 3, 668-684 (Mar 1975).

The relation between cross sections for quasifree scattering on clustering particles and separation energies of the particles in light nuclei is investigated. When the wave function for the center of mass of clustering particles relative to that of remaining ones has an oscillatory structure in the interior region, the overlap integral contains only a small contribution from this region. Consequently, the dominant contribution to the cross section will come from the asymptotic part of the wave function, which essentially depends on the binding energy of the clustering particles in the nucleus. This is a common situation in many cases of quasifree scattering on clustering particles. A theory based on this approach is able to explain the large variation in the magnitudes of a number of measured quasifree scattering cross sections. (auth)

1952 DOUBLE CHARGE EXCHANGE SCATTERING OF PIONS BY ^{18}O. Liu, L.C.; Franco, V. (Physics Department, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 11: No. 3, 760-771 (Mar 1975).

We calculate the cross section for the double charge exchange (DCE) reaction (π^+, π^-). The multiple-scattering series for DCE scattering of pions by nuclei is found to converge slowly. To take into account the higher-order contributions, we use an eikonalized distorted-wave formulation, which is obtained from the usual Glauber series by retaining those terms corresponding to coherent scattering processes. We include s, p, d, and f partial waves in the pion-nucleon (πN) elastic scattering amplitudes used in the calculations. Our results show that for incident pion energies below ~ 200 MeV the contribution of the spin-flip part of the πN elastic scattering amplitude to the cross section interferes significantly with that due to the spin-independent part of the πN amplitude. The d wave of the πN amplitude contributes significantly to the cross section above ~ 100 MeV. Above ~ 500 MeV the contribution from the f wave becomes important. The calculated total DCE cross section for ^{18}O$(\pi^+, \pi^-)^{18}$Ne has a minimum near 130 MeV. Although a maximum occurs near the (3, 3) resonance energy in both the double scattering and the double plus triple scattering cross sections, in the full distorted-wave results the maximum is located near 400 MeV and is rather broad. The forward differential cross section for DCE exhibits the same qualitative features as the integrated cross section as a function of the pion incident energy. The angular distributions are peaked in the forward direction and possess structure in the form of maxima and minima or shoulders. (auth)

1953 ANALYSIS OF THE ^{6}Li$(n,t)\alpha$ REACTION OVER THE ENERGY RANGE 14 TO 3900 keV. Lejeune, A.; Sartor, R. (Liege Univ. (Belgium). Inst. de Physique Nucleaire). J. Phys. (Paris); 35: No. 12, 895-897(Dec 1974).

New experimental data for the integrated and differential ^{6}Li$(n,t)\alpha$ cross sections, in the range 14 to 3900 keV, are analyzed within the framework of the S-matrix theory of nuclear reactions. A parametric expression is obtained. A $\frac{3}{2}^-$ level is located at $E_{exc} = 8.83$ MeV with a width equal to 1780 keV. (FR)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 1657, 1849, 1976, 1987, 2013, 2038, 2039, 2090, and 2117.

1954 (COO-1779-155, pp 14-15) COMPARATIVE STUDY OF THE (p,^{3}He) AND (p,t) REACTIONS ON T = ½ NUCLEI IN THE 2s–1d SHELL. Nann, H.; Wildenthal, B. H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1955 (COO-1779-155, pp 25-26) MULTISTEP PROCESSES IN THE ^{26,24}Mg(p,t)^{24,22}Mg REACTIONS. King, C. H.; Nann, H.; Shahabuddin, M. A. M.; Wildenthal, B. H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1956 (COO-1779-155, p 27) HIGHER-ORDER PROCESSES IN ^{22}Ne(p,t). Chien, W. S.; King, C. H.; Shahabuddin, H.; Nolen, J. A. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1957 (COO-1779-155, pp 28-29) SEARCH OF WEAK-COUPLING STRUCTURE IN (p,t) RESULTS. Nann, H.; Wildenthal, B. H.; Benenson, W.; Seth, K. K.; Saha, A. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1958 (COO-1779-155, pp 35-36) STUDY OF ^{12}C, ^{24}Mg, $^{40}Ca(\alpha,^{6}Li)$. Markham, R. G.; Shahabuddin, M. A. M. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

1959 (DESY-L-Ueb-187) RATIO OF THE PHOTO- AND ELECTRO-DISINTEGRATION CROSS SECTIONS OF NUCLEI AT HIGH ENERGIES. Noga, V. I.; Ranyuk, Yu. N.; Sorokin, P. V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 5p. (In German). INIS.
Published in Yad. Fiz. (1974) v. 19(5) p. 945-948.
Using the induced activity method the ratio is studied of the photo- and electrodisintegration cross sections of nuclei for the reactions $^{27}Al \rightarrow {}^{24}Na$ and $^{63,65}Cu \rightarrow {}^{58}Co$ in the energy interval 300-1,200 MeV. The measured results are compared with the calculations with various assumptions on the virtual and real photon spectra. (auth)

1960 STUDY OF THE REACTIONS $^{29,30}Si(^{3}He,n)^{31,32}S$ AND $^{35,37}Cl(^{3}He,n)^{37,39}K$. Reiter, A. Frankfurt am Main; Univ. Frankfurt am Main (1972). 50p. (In German). INIS.
Thesis.
Angular distributions of the reactions $^{29}Si(^{3}He,n)^{31}S$, $^{30}Si(^{3}He,n)^{32}S$, $^{35}Cl(^{3}He,n)^{37}K$ and $^{37}Cl(^{3}He,n)^{39}K$ were measured at an injection energy of 14 MeV (reaction 4 at 13 MeV). Highly enriched targets were used for this purpose. The neutrons were detected by proton recoil spectrometers. The experimental angular distributions were compared with the differential effective cross-sections calculated within the framework of the DWBA model; in these calculations, shell model wave functions are introduced which are tested by the comparison of the experimental and theoretical angular distribution. (GE)

1961 ASYMMETRY OF THE BETA-DECAY AND NUCLEAR MAGNETIC RESONANCE OF ^{28}Al, ^{38}Cl AND ^{116}In AFTER THE CAPTURE OF POLARIZED THERMAL NEUTRONS. Lades, H. Munich; Technische Univ. (1972). 36p. (In German). INIS.
Thesis.
The asymmetry of the β-decay polarized nuclei enables the detection of nuclear polarization and thus the study of a few properties of β-active nuclei and their interaction with the surroundings. In some cases, the capture of polarized thermal neutrons is a suitable method of producing β-active nuclei with a measurable degree of polarization. In the present work, polarized ^{28}Al, ^{38}Cl and ^{116}In nuclei were produced by the above method. With the help of the nuclear magnetic resonance, the nuclear magnetic moments of ^{28}Al and ^{38}Cl could be newly determined and an earlier result of another author on ^{116}In could be confirmed. The lifetime range determined with this method was considerably extended with the application to ^{38}Cl. The β-asymmetry on ^{118}In was observed in superconducting metal among others. Further possibilities of application of the method in a more intense beam are discussed. (GE)

1962 GAMMA SPECTROSCOPY WITH ^{34}Ar. Loehle, U. Freiburg i.B; Univ. Freiburg i.B (1973). 62p. (In German). INIS.
Thesis.
Excited states in populated ^{34}Ar were γ spectroscopically investigated with a Ge(Li) detector by means of the reaction $^{32}S(^{3}He^{++},n)^{34}Ar$. Direct n-$\gamma$ coincidence and n-γ-γ triple coincidence spectra were recorded. The level and decay scheme was determined and the lifetime of the low excitation states were found. By means of an n-γ angular correlation, the spins of the levels at 2.091 MeV, 3.288 MeV, 3.869 MeV, 4.126 MeV and 4.517 MeV were determined. Statements are made on the spins of the levels at 4.631 MeV, 5.255 MeV and 5.542 MeV from analogy considerations on the mirror nucleus ^{34}S. The branching ratio and mixing ratio as well as the transition strengths are given. The experimentally determined excitation energies and transition strengths are finally compared with model calculations. (GE)

1963 EVIDENCE FOR THE COEXISTENCE OF SPHERICAL AND DEFORMED STATES IN ^{32}Ar. Betz, P.; Roepke, H.; Glatz, F.; Hammel, G.; Glattes, V.; Brendler, W. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys.; 271: No. 2, 195-199(Dec 1974).
The ^{32}Ar levels at E_x = 5.350, 7.289 and 9.341 MeV have been investigated using the $^{35}Cl(\alpha,p\gamma)$ reaction at E_α = 14 and 14.5 MeV. From particle-γ-ray angular correlations the spin assignments J(5.350) = 4, J(7.289) = 6, 4 and J(9.341) = 8, 6, 4, have been obtained. Lifetime measurements using the Doppler-shift attenuation method yielded τ(9.341) = 106 ± 25 fs and τ(7.289) = 77 ± 30 fs, while the lifetime τ(5.350) = 200 ± 50 fs was known previously. All levels have positive parity and decay by enhanced E2 transitions. It is proposed that they are the J^π = 4^+, 6^+ and 8^+ members, respectively, of a $K^\pi = 0^+$ rotational band which has the E_x 3.377 MeV, $J^\pi = 0^+$ and the 3.937 MeV, $J^\pi = 2^+$ levels as further members. The enhancement of inband E2 transitions is 30 + 10 – 6 W.u. (4 → 2), 35 + 30 – 14 W.u. (6 → 4) and 20-36 W.u. (8 → 6), respectively, yielding an average intrinsic quadrupole moment Q_0 = 850 + 200 – 125 mb. The moment of inertia is given by $\hbar^2/2\theta$ = 92 keV. The present data are in good agreement with the predictions of a deformed state in ^{38}Ar that coexists with the spherical states. (auth)

1964 THE ANGULAR MOMENTUM DEPENDENCE OF CORRELATIONS IN THE GROUND STATE ROTATIONAL SPECTRA OF ^{20}Ne AND ^{22}Ne. Schmid, K. W.; Krewald, S. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik); Satpathy, L. (Berhampur Univ. (India). Dept. of Physics). Z. Phys.; 271: No. 2, 149-159(Dec 1974).
Multi-Configuration-Hartree-Fock (MCHF) calculations with angular momentum projection before the variation of the internal degrees of freedom have performed for the nuclei ^{20}Ne and ^{22}Ne. This procedure yields different correlated intrinsic states for the different members of a rotational band. Thus the angular momentum dependence of correlations has been studied. Experimentally, the ground state spectra of ^{20}Ne and ^{22}Ne show properties similar to the phase transitions observed in some rare earth nuclei which have been well reproduced through the present calculations. The calculated spectra and BE2-values show a significant improvement compared to the ones obtained by variation before the angular momentum projection is effected. (auth)

1965 PRECISION MEASUREMENTS OF MAGNETIC MOMENTS OF NUCLEI WITH WEAK NMR SIGNALS. Sahm, W.; Schwenk, A. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Naturforsch., a; 29: No. 12, 1763-1766(Dec 1974).
Two NMR spectrometers were combined and a special probe assembly was constructed in order to enable a simultaneous measurement of the signals of ^2H and any nucleus, the gyromagnetic ratio of which is $<1.4 \times 10^7$ T^{-1} sec^{-1}. The Larmor frequencies of ^{39}K, ^{73}Ge, and ^{109}Ag in well-defined samples were referred very accurately to the resonance of ^2H in D_2O. It was possible now to refer the Larmor frequencies of the nuclei ^{41}K, ^{57}Fe, ^{87}Sr, ^{107}Ag, ^{183}W, ^{187}Os, which were previously referred to the resonance of one of the nuclei mentioned above, to the Larmor frequencies of the deuteron and the proton in D_2O or H_2O. The magnetic moments of all these nuclei are given. (GE)

1966 USE OF A SMALL ACCELERATOR TO STUDY THE GAMMA RAYS ASSOCIATED WITH THE INELASTIC SCATTERING OF 14-MeV NEUTRONS IN ^{28}Si, ^{32}S, AND ^{48}Ti. Connell, K. A.; Cox, A. J. (Aston Univ., Birmingham, Eng.). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 71-78(Feb 1975).
The γ-rays associated with the inelastic scattering of 14-MeV neutrons in ^{28}Si, ^{32}S and ^{48}Ti are investigated. In each case the differential cross section in the range of 0 to 90° is measured with angular resolution of ±4°. The neutrons are produced using the $^2D(T,n)^4\alpha$ reaction. A time-of-flight technique using the α particle associated with production of the neutron to give a zero time signal is used to reduce background interference. (auth)

1967 ANALYSES OF ANOMALOUS LARGE ANGLE INELASTIC ALPHA PARTICLE SCATTERING. Ruzzene, F.; Amos, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 271: No. 4, 359-365(Dec 1974).
Inelastic alpha particle scatterings to selected states in ^{24}Mg, ^{28}Si and ^{40}Ca are analyzed. The transitions, all of which display anomalous structure in their differential cross sections at large scattering angles, are weakly, if at all, promoted by normal first order inelastic scattering reaction processes. To explain the anomalous structure, a two step reaction model in which the intermediate states are quasi-molecular is utilized. The energy variation of large angle scattering data shows that the quasi-molecular intermediate states form a rotational band identical to that required to explain anomalous structure in the angular distributions of elastically scattered alpha particles. (auth)

1968 ANOTHER METHOD OF SEARCHING FOR PROTON DECAY. Rosen, S.P. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. Lett. 34: No. 12, 774-776 (24 Mar 1975).
A geochemical method of searching for proton decay, similar to the one used for double-β decay, is discussed. If a proton inside such nuclei as ^{23}Na, ^{39}K, $^{85,87}Rb$, and ^{133}Cs can decay, then anomalous amounts of

the rare-gas isotopes ^{22}Ne, ^{38}Ar, ^{84,86}Kr, and ^{132}Xe may be found occluded in ancient ores. (auth)

1969 GAMMA-RAY TRANSITIONS IN ^{21}Ne. Lawson, J.C.; Chagnon, P.R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 11: No. 3, 643-647 (Mar 1975).

γ rays have been studied in coincidence with protons from the ^{19}F(^{3}He, p)^{21}Ne reaction. In addition to known decays, branching ratios have been measured for about 14 weak transitions. By means of $p\gamma$ angular-correlation experiments, spin assignments $J = 1/2$ and $3/2$ are confirmed for $E_x = 2789$ and 3662 keV, respectively. New spin assignments are $J = 3/2$, $(3/2)$, and $(9/2)$ for $E_x = 4684$, 5550, and 6265 keV, respectively. Results are consistent with the unified rotational model of ^{21}Ne. (auth)

1970 STRUCTURE OF ^{33}S FROM A STUDY OF THE ^{34}S(p, d)^{33}S REACTION AT 35 MeV. Moalem, A.; Wildenthal, B.H. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 11: No. 3, 654-663 (Mar 1975).

The ^{34}S(p, d)^{33}S reaction has been studied at a proton energy of 35 MeV. Deuteron spectra were analyzed in a magnetic spectrograph with an over-all energy resolution, full width at half-maximum, of about 8 keV. Excitation energies were measured for levels in ^{33}S through 7.5 MeV excitation with an accuracy of ± (1.0 keV + 0.5 keV per 1 MeV of excitation). Values of the orbital angular momenta of neutrons transferred in these transitions, and the corresponding spectroscopic factors, were extracted from the data by means of distorted-wave Born-approximation calculations. Several new $J^\pi = (1/2)^+$ assignments were made. The experimental results are compared to the predictions of current nuclear structure theories for this nucleus. (auth)

1971 E 0 DECAY OF THE FIRST EXCITED 0$^+$ STATE IN ^{32}S. Adloff, J.C.; Souw, K.H.; Disdier, D.; Chevallier, P. (Centre de Recherches Nucléaires, Université Louis Pasteur, Strasbourg, France). Phys. Rev. C 11: No. 3, 738-741 (Mar 1975).

The E 0 branching ratio Γ_e/Γ of the ^{32}S (3.78-MeV, 0$^+$) state to the ground state was measured to be $(3.54 \pm 0.62) \times 10^{-4}$. When combined with the lifetime $\tau_m = (0.90 \pm 0.15)$ psec of this state one obtains the value $\langle M \rangle_n = (2.22 \pm 0.27)$ fm^2 for the E 0 matrix element. (auth)

1972 ELECTROMAGNETIC TRANSITIONS IN ^{22}Na. Spear, R.H.; Bell, R.A.I.; Esat, M.T.; Gardner, P.R.; Kean, D.C. (Department of Nuclear Physics, Australian National University, Canberra, Australia); Baxter, A.M. Phys. Rev. C 11: No. 3, 742-755 (Mar 1975).

Electromagnetic properties of excited states of ^{22}Na below 4.6-MeV excitation energy have been studied using the ^{23}Na(^{3}He, $\alpha\gamma$)^{22}Na and ^{19}F(α, $n\gamma$)^{22}Na reactions. Investigation of the decay scheme of the 4069-keV level using the ^{23}Na(^{3}He, $\alpha\gamma$)^{22}Na reaction shows a (10 ± 3)% branch to the 1528-keV level, compared to a value of 21% reported previously. The existence of weak γ-ray transitions from the 1983-, 2211-, and 2572-keV levels has been confirmed from γ-ray spectra obtained above and below threshold for population of these levels via the ^{19}F(α, n)^{22}Na reaction. A long standing controversy regarding the spin of the 1983-keV level has been resolved by γ-ray angular distribution measurements close to threshold for the population of the 1983-keV level via the ^{19}F(α, n)^{22}Na reaction; the results show that $J^\pi(1983) = 3^+$. Neutron-γ correlation studies of the ^{19}F(α, $n\gamma$)^{22}Na reaction, taken in conjunction with previous data, impose limitations on spins and parities of several levels and on mixing ratios of associated γ-ray transitions. The spin-parity values are as follows, relatively unlikely assignments being bracketed: $J^\pi(3708) = 6^+(4^+)$; $J^\pi(4069) = 4^+$; $J^\pi(4466) = 1^-$, 2^+, 3^-, or 4^-; $J^\pi(4522) = 7^+$, $5^+(4^-, 6^+)$. (auth)

1973 ISOSCALAR GIANT RESONANCE IN LIGHT NUCLEI ($A \leq 40$). Moss, J.M.; Rozsa, C.M.; Youngblood, D.H.; Bronson, J.D.; Bacher, A.D. (Cyclotron Institute and Physics Department, Texas A&M University, College Station, Texas 77843). Phys. Rev. Lett. 34: No. 12, 748-751 (24 Mar 1975).

The giant-resonance region was studied for ^{40}Ca, ^{40}Ar, ^{36}Ar, ^{32}S, ^{28}Si, ^{27}Al, ^{20}Ne, and ^{16}O by inelastic scattering of 96.6-MeV α particles. A systematic broadening of the isoscalar giant resonance at $E_{exc} \simeq 63/A^{1/3}$ MeV occurs as A decreases. The width for ^{40}Ca is 3.5±0.3 MeV, for ^{32}S it is 7.1±0.5 MeV, and for nuclei below A=32 the resonance is too diffuse to be observed. (auth)

1974 NONPECULIAR BEHAVIOR OF THE (^{16}O, ^{12}C) TRANSFER REACTION IN THE s-d SHELL. Erskine, J.R.; Henning, W.; Kovar, D.G.; Greenwood, L.R. (Argonne National Laboratory, Argonne, Illinois 60439); DeVries, R.M. Phys. Rev. Lett. 34: No. 11, 680-683 (17 Mar 1975).

Recent analyses of (^{16}O, ^{12}C) four-nucleon transfer data in the s-d shell have suggested (a) that the transfer occurs with the α cluster in its 28.5-MeV excited state, and separately (b) that weakly absorbing optical potentials must be used. Our analysis of four-nucleon transfers measured in the reaction ^{24}Mg(^{16}O, ^{12}C)^{28}Si contradicts such peculiar features in the (^{16}O, ^{12}C) reaction, and yields spectroscopic information in agreement with theoretical predictions. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 1942, 1959, 1967, 1968, 1973, 2006, 2008, 2013, 2038, 2039, 2090, and 2117.

1975 (COO-1779-155, pp 1-3) PROTON-RICH NUCLEI. Mueller, D.; Kashy, E.; Benenson, W.; Nann, H. Sep 1974. In annual report, July 1, 1973–July 1, 1974.

1976 (COO-1779-155, pp 16-17) (α,d) REACTION ON ODD-A NUCLEI IN THE 2s–1d SHELL. Chien, W. S.; Wildenthal, B. H.; Nann, H. Sep 1974. In annual report, July 1, 1973–July 1, 1974.

1977 (COO-1779-155, pp 30-31) (^{3}He,^{7}Be) STUDIES FROM A = 12 TO 206. Steele, W. F.; Crawley, G. M. Sep 1974. In annual report, July 1, 1973–July 1, 1974.

1978 (COO-1779-155, pp 51-52) DECAY MODES IN THE GIANT RESONANCE REGION OF ^{40}Ca. Moalem, A.; Benenson, W.; Bertsch, G.; Crawley, G. M.; Khoo, T. L. Sep 1974. In annual report, July 1, 1973–July 1, 1974.

1979 (COO-1779-155, p 53) ODD-PARITY ROTATIONAL-BAND STRUCTURE IN ^{49}V. Samuelson, L. E.; Kelly, W. H.; Bernthal, F. M.; Warner, R. A.; McHarris, W. C. Sep 1974. In annual report, July 1, 1973–July 1, 1974.

1980 STUDY ON THE SPIN DEPENDENCE OF PARTICLE EMISSION FROM HEAVY ION INDUCED COMPOUND NUCLEUS REACTIONS. Franke, H. Erlangen, Ger.; Univ. Erlangen–Nuremburg (1972). 77p. (In German). INIS.

Thesis.

The effect of the angular momentum on the particle emission of compound nuclei has been investigated. The dependence of the two or three particle emission on compound nuclear spin was investigated on the compound nucleus ^{61}Cu. The compound systems $I >$ (^{45}Sc + ^{16}O) and $I <$ (^{47}Ti + ^{14}N) were produced with the same excitation energy but different spin distribution by two different target projectile combinations and both systems were compared for their relative strengths of two and three particle emission. (GE)

1981 MAGNETIC MOMENT OF THE 2-LEVEL AT 235 keV IN ^{44}Sc. Brandolini, F. (Univ., Padua); Rossi Alvarez, C.; Vingiani, G. B.; de Poli, M. Lett. Nuovo Cim.; 12: No. 12, 433-435(22 Mar 1975).

The g-factor of the 2$^-$ level at 235 keV was measured, and a value of $g = +0.34 \pm 0.05$ agrees with the one of the 1$^-$ 68 keV level giving strong support to the hypothesis that a rotational description is a good approach. (JFP)

1982 TOTAL CROSS SECTION AND STELLAR REACTION RATES FOR THE ^{58}Ni(p,γ)^{59}Cu REACTION. Hall, T. H.; Cameron, J. M.; McCamis, R. H.; Moss, G. A. (Univ. of Alberta, Edmonton). Can. J. Phys.; 53: No. 5, 445-449(1 Mar 1975).

Measurements were made of the total cross section for the radiative capture of protons by ^{58}Ni for proton energies from 1.4 to 4.8 MeV using activation techniques. The 1.301-MeV γ rays emitted in the decay of ^{59}Ni* following the β^+ decay of ^{59}Cu were observed. This reaction is important in the later stages of stellar nucleosynthesis through its role in the particle rich e process, where it is believed to affect the final abundances of ^{58}Ni, ^{59}Cu, and ^{59}Co produced in some supernovae explosions. From these, and renormalized earlier resonant strength measurements, stellar reaction rates are calculated for temperatures from 2 to 6×10^9 K and found to be lower by about a factor of two than those currently used in model calculations. (auth)

1983 STUDY OF PF-SHELL NUCLEI WITH A SYMMETRY CONSERVING GENERATOR COORDINATE METHOD. Goeke, K. (Oxford Univ. (UK). Dept. of Theoretical Physics); Allaart, K.; Muether, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 271: No. 4, 377-389(Dec 1974).

Bands based on the O$^+$ ground state the first excited O$^+$ pairing vibrational state of ^{48}Ti, ^{52}Cr, and ^{56}Fe are studied with the generator coordinate method. The generating wave functions for each value of the angular momentum J are angular momentum and particle number projected selfconsistent Hartree-Fock-Bogoliubov states where the constrained amount of pairing correlations serves as the generator coordinate. The interaction is given by reaction matrix elements derived from the Hamada-Johnston force. The basis includes the four lowest oscillator shells. (GE)

1984 RESONANCE REACTIONS: ISOBARIC ANALOG RESONANCES IN HEAVY NUCLEI. von Brentano, P. (Univ., Cologne); Cramer, J. G. pp 89-135 of Nuclear Spectroscopy and Reactions, Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).

The study of isobaric analog resonances (IAR) in heavy nuclei through elastic proton scattering is discussed, and an extension is made to inelastic scattering. A brief discussion is given of the investigation of IAR through nuclear reactions with emphasis on cases where the resonance is either formed or decays through particles other than protons. The relation between the partial proton decay width obtained in a resonance and spectroscopic factors is discussed. Some technical aspects of experimental techniques in the study of IAR are presented. (7 figures, 3 tables, 124 references) (SDF)

1985 *K*-SHELL INTERNAL IONIZATION IN *K*-CAPTURE DECAY OF ^{55}Fe. Kitahara, T.; Shimizu, S. (Institute for Chemical Research and Radioisotope Research Center, Kyoto University, Kyoto, Japan). Phys. Rev. C 11: No. 3, 920-926 (Mar 1975).

The energy spectrum of *K* electrons ejected from ^{55}Fe during *K*-capture decay has been measured in the energy range from 5 to 180 keV. In addition, a value of the total *K*-shell internal ionization probability per *K* capture has been estimated experimentally. The phenomenon was observed by the triple-coincidence (*K*-x–ejected e^-–*K*-x) experiment using a gas proportional counter for ejected electrons and two gas proportional counters for Mn *K* x rays. For the higher-energy region of ejected electrons, the confinement of the electrons within the sensitive volume of the electron counter was achieved by applying a magnetic field. The *L*-shell contributions were rejected completely by the triple-coincidence technique. A fairly good agreement between our measured spectrum and theoretical curves, recently calculated relativistically by the present authors and by Intemann, is established even in the low-energy region down to 5 keV. The total ionization probability also agrees with the theoretical predictions within an experimental error. (auth)

1986 DECAYS OF THE $f_{7/2}$ ISOMERS ^{53}Fe^g AND ^{53}Fe^m. Black, J.N.; McHarris, W.C. (Department of Chemistry, Cyclotron Laboratory, and Department of Physics, Michigan State University, East Lansing, Michigan 48824); Kelly, W.H.; Wildenthal, B.H. Phys. Rev. C 11: No. 3, 939-951 (Mar 1975).

The decays of 8.5-min ^{53}Fe^g and 2.5-min ^{53}Fe^m have been studied with a variety of γ and β^+ detectors in many different singles and coincidence configurations. States in ^{53}Mn populated by ^{53}Fe^g decay were found to lie at 0 ($J^\pi = 7/2^-$), 377.9 ($5/2^-$), 1288.0 ($3/2^-$), 1619.9 ($9/2^-$), 2273.5 ($5/2^-$), 2685.6 ($7/2^-$), 2946.6 ($9/2^-$), 3126.7 ($9/2^-$, $7/2^-$, $5/2^-$), and 3248.0 keV ($[9/2]^-$). States in ^{53}Fe populated by 3040.6-keV ($19/2^-$) ^{53}Fe^m decay were confirmed at 0 ($7/2^-$), 1328.1 ($9/2^-$), and 2339.6 keV ($11/2^-$). In addition, a 3040.6-keV *E6* and a 1712.6-keV *M5* transition were found to compete with the 701.1-keV *E4* isomeric transition in deexciting ^{53}Fe, this being the first observation of such high multipolarities. The *E6* has an intensity of 6.0×10^{-4} and the *M5* an intensity of 1.3×10^{-2} relative to the *E4* transition. The *E4*, *M5*, and *E6* transitions are retarded by respective factors of 7.6, 4.2, and 4.3 with respect to single-particle estimates and by somewhat larger factors with respect to simple shell-model estimates. (auth)

1987 DECAY SCHEMES FOR HIGH-SPIN STATES IN ^{42}K AND ^{42}Ca. Warburton, E.K.; Kolata, J.J.; Olness, J.W. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 11: No. 3, 700-709 (Mar 1975).

Fusion-evaporation reactions induced by ^{18}O and ^{19}F bombardment of ^{26}Mg, ^{27}Al, and ^{28}Si targets with projectile energies of 20–60 MeV were used to populate high-spin states in ^{42}K and ^{42}Ca. Ge(Li) measurements of γ-γ coincidences, together with γ-ray angular distribution and linear polarization measurements, were used to establish decay schemes, excitation energies, spin-parity assignments, and γ-ray transition multipolarities. These data, together with recoil-distance measurements of lifetimes, provide information also on transition strengths for the deexcitation γ rays. Our results suggest assignments of 6^+ and 7^+ for ^{42}K levels at 1376 and 1948 keV, respectively, and indicate higher-lying levels of presumably greater spin. In ^{42}Ca, new odd-parity levels from 6^- to 11^- are proposed as arising from the $d_{3/2}{}^{-1}f_{7/2}{}^3$ configuration. (auth)

1988 LOW-ENERGY LEVELS AND GAMMA TRANSITIONS IN ^{58}Co. Brunner, B.J.; Arns, R.G.; Caldwell, S.E.; Rozsa, C.M.; Smith, J.W.; Sprague, S.W. (The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 11: No. 3, 1042-1047 (Mar 1975).

The mean lifetimes of eight excited states in ^{58}Co have been measured by the Doppler-shift-attenuation method using the reaction ^{55}Mn(α, $n\gamma$)^{58}Co at $E_\alpha = 9.5$ MeV. γ rays were detected at 30 and 150° to the beam axis in a 38.5 cm^3 Ge(Li) detector. The following mean lifetimes were measured (τ in psec): τ (366 keV level) $= 1.70_{-0.60}{}^{+1.00}$, τ (374) $= 2.10_{-0.70}{}^{+1.30}$, τ (457) $= 1.25_{-0.38}{}^{+0.45}$, τ (886) $= 0.25_{-0.07}{}^{+0.11}$, τ (1184) $= 0.24_{-0.07}{}^{+0.12}$, τ (1354) $= 0.90_{-0.32}{}^{+2.00}$, τ (1378) $= 0.23_{-0.08}{}^{+0.13}$, τ (1435) $= 0.87_{-0.30}{}^{+3.00}$. Angular distributions of six γ rays were measured using the reaction ^{58}Fe(p, $n\gamma$)^{58}Co at $E_p = 3.33$–4.73 MeV. The results were compared with Hauser-Feshbach calculations, and the following spin assignments were made: 112 keV level, 3^+; 366 keV, 3^+; 374 keV, 5^+; 457 keV, 4^+, 1040 keV, 3^+; 1435 keV, 1^+ $(0, 2, 3)^+$. (auth)

1989 APPLICATION OF THE GENERALIZED SEMIMICROSCOPIC MODEL TO $1f_{7/2}$ NUCLEI. Abecasis, S.M.; Heras, C.A. (Laboratorio de Radiaciones, IIAE, Departamento de Física, Facultad de Ciencias Exactas y Naturales, Ciudad Universitaria, Pabellón 1, Buenos Aires, Argentina); Krmpotić, F. Phys. Rev. C 11: No. 3, 1015-1030 (Mar 1975).

A detailed description with the generalized semimicroscopic model of the properties of the low-lying states of ^{49}Ti, ^{51}Cr, and ^{57}Co is performed. The last one is taken as a typical and well-known representative of the odd-mass cobalt isotopes. Calculated energy-level sequence, electromagnetic properties, spectroscopic factors, and lifetimes compare favorably with experiment. (auth)

1990 BACK-ANGLE ANOMALIES IN ALPHA SCATTERING: INELASTIC SCATTERING FROM THE CALCIUM ISOTOPES. Trombik, W.; Eberhard, K.A.; Eck, J.S. (Sektion Physik, Universität München, D-8046 Garching, Germany). Phys. Rev. C 11: No. 3, 685-692 (Mar 1975).

Cross sections for elastic and inelastic α scattering on ^{40,42,44,48}Ca have been measured to several excited states. The bombarding energy (lab) is 24 MeV for $\alpha + {}^{40,42,44}$Ca and is 24 and 29 MeV for $\alpha + {}^{48}$Ca. Particular emphasis is given to the back-angle data. In addition to the anomaly of $\alpha + {}^{40}$Ca elastic scattering at backward angles previously reported by many workers anomalous features are also observed in inelastic scattering. It is found that the backward anomaly of the $\alpha + {}^{40}$Ca inelastic cross sections is strongest for the 0^+ states and gradually decreases with increasing spins of the final states (1^-, 3^-, 5^-). The only exception is the scattering to the 2^+ state at 3.90 MeV, for which the cross sections exhibit a regular decrease toward backward angles. The inelastic cross sections for the ^{42,44,48}Ca isotopes are generally smaller at backward angles as compared to those for ^{40}Ca. In general, the observed anomalies for inelastic scattering at back angles are in close analogy to those known for elastic scattering. An interpretation of the data and of the anomalies in terms of coupled channels is given. Both a standard optical potential and one with an angular-momentum-dependent absorption have been used in the calculations. It is found that the large differences in the cross sections at backward angles, depending on the isotope and on the spin of the residual state, can be reproduced by coupled-channel calculations when an angular-momentum-dependent absorption in the optical potential is assumed. (auth)

1991 ^{16,18}O ELASTIC SCATTERING FROM ^{58}Ni. Zisman, M.S.; DeVries, R.M.; Cramer, J.G.; Liu, K.; Chan, Y.; Cuengco, B. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. C 11: No. 3, 809-814 (Mar 1975).

The elastic scattering of ^{18}O + ^{58}Ni at 63.4 MeV and ^{16}O + ^{58}Ni at 63, 71.5, and 81 MeV has been studied and optical model fits have been obtained. The data indicate that weakly absorbing optical potentials of the type used in some recent distorted-wave Born-approximation calculations are inconsistent with back-angle elastic scattering. A five-parameter surface transparent optical potential with $a_I < a_R$ has been found which reproduces the elastic scattering over this energy range and appears to be capable of qualitatively reproducing the observed forward peaked and oscillatory transfer reaction angular distributions in this mass region. (auth)

1992 PRE-EQUILIBRIUM ALPHA EMISSION INDUCED BY DIFFERENT INCIDENT CHANNELS: EVIDENCE FOR ALPHA PREFORMATION IN NUCLEI. Chevarier, A.; Chevarier, N.; Demeyer, A.; Hollinger, G.; Pertosa, P.; Tran Minh Duc (Institut de Physique Nucléaire, Université Claude Bernard Lyon-I and IN2P3, 43 Bd du 11 novembre 1918, 69621 Villeurbanne, France). Phys. Rev. C 11: No. 3, 886-894 (Mar 1975).

A study of α emission induced by different incident channels has been undertaken. Measurements of energy spectra and angular distributions of α particles emitted in proton-, deuteron-, ^{3}He-, and α-induced reactions were performed. An analysis in the frame of the pre-equilibrium model succeeds in giving an over-all description of all particle spectra. The α particle being in this approach considered as an exciton, a preformation factor around 0.2 for four nucleons to be correlated as an α particle has been obtained. The α preformation probability deduced from this analysis is independent of the proton, deuteron, ^{3}He incident channel, incident energy, and mass of target nuclei. (auth)

1993 COULOMB-NUCLEAR INTERFERENCE FOR THE ^{58}Ni(^{14}N, ^{14}N) REACTION. Baker, F.T.; Kruse, T.H.; Hartwig, W.; Williams, M.E. (Department of Physics, Rutgers University, New

Brunswick, New Jersey 08903); Savin, W. Phys. Rev. C 11: No. 3, 1051-1053 (Mar 1975).

Interference between Coulomb and nuclear excitation has been observed for excitation of the first 2^+ state of ^{58}Ni by inelastic scattering of ^{14}N. For classical impact parameters corresponding to "grazing collisions" the interference is strongly destructive indicating a predominantly real nuclear form factor. (auth)

1994 PHOTOPRODUCTION OF π^+ FROM ^{51}V. Freed, N. (Department of Physics, Pennsylvania State University, University Park, Pennsylvania 16802); Ostrander, P. Phys. Rev. C 11: No. 3, 805-808 (Mar 1975).

The reaction $^{51}V(\gamma, \pi^+)^{51}Ti$ is investigated within the impulse approximation. A detailed shell-model calculation is carried out to determine the character of the final nuclear states. We discuss the dependence of the reaction on the single-nucleon production amplitudes, nuclear wave functions, and simulated final-state interactions. (auth)

1995 MEASUREMENT OF REACTION CROSS SECTIONS FOR ^{40}Ca(alpha,gamma)^{44}Ti, ^{40}Ca(alpha,p)^{43}Sc, and ^{48}Ca(alpha,n)^{51}Ti WITH APPLICATIONS TO NUCLEOSYNTHESIS IN STARS. Barker, D. L. Tucson, AZ; Univ. of Arizona (1974). 108p. University Microfilms Order No. 75-4137.

Thesis (Ph. D.).

The cross section for the reactions ^{40}Ca(alpha,gamma)^{44}Ti, ^{40}Ca(alpha,p)^{43}Sc and ^{48}Ca(alpha,n)^{51}Ti were measured between the center of mass energies of 3.5 MeV and 9.0 MeV with the following results: ^{40}Ca(alpha,gamma)^{44}Ti: omegagamma equals 7 +- 1.5 eV; E/sub R/ equals 4.109 MeV, ^{40}Ca(alpha,p)^{43}Sc: 5nb less than or equal to sigma less than or equal to 3×10^3 nb; 4 less than or equal to E less than or equal to 9 MeV, ^{48}Ca(alpha,n)^{51}Ti: 9×10^{-2} mb less than or equal to sigma less than or equal to 2×10^2 mb; 3.5 less than or equal to E less than or equal to 6 MeV. These cross sections have been used to calculate reaction rates as a function of temperature for stellar interior and compared to theoretical predictions of the "Equivalent Square Well" model. Analytical expressions are given for (sigmav) as a function of temperature. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 1965, 1968, 1977, 1983, 1984, 1992, 2023, 2038, 2039, 2086, and 2118.

1996 (COO-1779-155, p 20) ^{64}Ni(p,t) REACTION AT 40 MeV. Kong-A-Siou, D. H.; Nann, H.; Benenson, W. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1997 (COO-1779-155, pp 21-22) SPECTROSCOPIC STUDY OF ^{60,61}Ni BY (p,d) REACTION. Kong-A-Siou, D. H.; Chien, W. S.; Rossner, H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

1998 (COO-1779-155, p 23) STUDY OF THE (p,d) REACTION ON THE GERMANIUM ISOTOPES. Show, D. L.; Wildenthal, B. H.; Nolen, J. A. Sep 1974.

In annual report, July 1,1973–July 1, 1974.

1999 (COO-1779-155, p 45) SHELL MODEL CALCULATIONS FOR THE FP SHELL NUCLEI. Kong-A-Siou, D. H.; Wildenthal, B. H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2000 INVESTIGATION OF LOW LYING $d_{\frac{5}{2}}$ ISOBARIC ANALOG RESONANCES WITH POLARIZED PROTONS. Kretschmer, W. Erlangen, Ger.; Univ. Erlangen–Nuremburg (1972). 51p. INIS.

Thesis.

Low lying $d_{\frac{5}{2}}$ isobaric analog resonances have been investigated in the elastic scattering of polarized protons near 5 MeV incident proton energy on the target nuclei ^{88}Sr, ^{89}Y, ^{90}Zr and ^{92}Zr at laboratory angles 40°, 60°, 90°, 120°, 140° and 160°. It is shown that the compound elastic contribution to the energy averaged differential cross section is significant at backward angles and that a model independent separation of direct and compound elastic cross section is possible by using polarized protons. Direct and compound nucleus scattering are analyzed in a consistent manner, and the results indicate that the mechanism of internal isospin mixing dominates in these IAR's, where due to the Coulomb barrier external mixing is strongly reduced. (auth)

2001 NEW DETERMINATION OF THE HALF-LIFE OF ^{87}Rb BY COMPARISON OF MEASUREMENTS USING THE SEPARATED ISOTOPES ^{87}Rb AND ^{85}Rb. Neumann, W. Muenster, Ger.; Univ. Muenster (1973). 59p. (In German). INIS.

Thesis.

The half-life of the natural β-emitter ^{87}Rb has been newly determined by counting the decays in a 4π-proportional counter tube. Due to the low ^{87}Rb activity, the zero effect of the counter tube was decreased to 31 cpm by anticoincidence and iron screening. Comparative measurements with (inactive) ^{85}RbCl layers showed that the RbCl layers do not influence the zero effect in the energy region above 185 eV. The difference of the count rates of activity and zero effect measurements above 185 eV could thus be considered as the β-activity of ^{87}Rb. By extrapolating the specific activities to the layer thickness zero, the following half-life was obtained: $T = (4.88 + 0.06, -0.10) \times 10^{10}$ a. (GE)

2002 ISOBARIC ANALOGUE STATES EXCITED IN THE ^{59}Co(p,γ)^{60}Ni REACTION. Erlandsson, B.; Lyttkens, J.; Marcinkowski, A. (Lund Univ. (Sweden). Dept. of Nuclear Physics). Z. Phys.; 272A: No. 1, 67-75(1975).

The ^{59}Co(p,γ)^{60}Ni reaction has been investigated in the proton energy region 1,365–2,150 keV. Decay schemes and branching ratios have been determined for ten resonances, five of which have been identified as possible analogs or fragments of analogs of the ground state (5^+) and the 58.6 keV (2^+), 277.1 keV (4^+), 288.4 keV (3^+), and 435.7 keV (5^+) levels in ^{60}Co. At eight of the resonances most of the decay seems to go via a group of states with an excitation energy of 5–9 MeV. The investigated analog states give a Coulomb displacement energy of 9,118(7) keV. (auth)

2003 DECAY OF ^{61}Fe TO LEVELS IN ^{61}Co. Bron, J.; Jongsma, H.W.; Verheul, H. (Natuurkundig Laboratorium der Vrije Universiteit, Amsterdam, The Netherlands). Phys. Rev. C 11: No. 3, 966-973 (Mar 1975).

Single γ ray, γ-γ coincidence, and level spectrometer studies have been performed on the decay of ^{61}Fe ($T_{1/2} = 5.98 \pm 0.06$ min). 48 γ transitions with energies up to 3365 keV are assigned to this decay and 22 levels are proposed in the ^{61}Fe decay scheme. Spins and parities of levels in ^{61}Co are given. The level structure of ^{61}Co is compared with neighboring odd Co nuclei. (auth)

2004 LIFETIME MEASUREMENTS IN ^{80}Kr AND ^{81}Rb. Friederichs, H.; Gelberg, A.; Heits, B.; Lieb, K.P.; Uhrmacher, M.; Zell, K.O.; von Brentano, P. (Institut für Kernphysik der Universität zu Köln, Germany). Phys. Rev. Lett. 34: No. 12, 745-747 (24 Mar 1975).

We measure the lifetimes of excited states in ^{81}Rb and in the core nucleus ^{80}Kr. Ratios of reduced transition probabilities in ^{80}Kr are consistent with those given by the rotational model. The B ($E2$) of the $13/2^+$ state in ^{81}Rb is in agreement with the particle-plus-rotor value and inconsistent with the weak-coupling prediction. The B ($E2$) values of the $17/2^+$ and $21/2^+$ states lie much higher than predicted by several models. (auth)

2005 SYSTEMATIC STUDY OF THE PHOTODISINTEGRATION OF ^{70}Ge, ^{72}Ge, ^{74}Ge, AND ^{76}Ge. McCarthy, J.J.; Morrison, R.C.; Vander Molen, H.J. (Ames Laboratory-USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. C 11: No. 3, 772-781 (Mar 1975).

Cross sections for the (γ, n), (γ,2n), and the (γ, np) reactions for ^{70}Ge, ^{72}Ge, ^{74}Ge, and ^{76}Ge and the (γ,p) reaction for ^{74}Ge have been measured from threshold to 40 MeV at the Iowa State University Synchrotron Laboratory. Cross section results were obtained by unfolding bremsstrahlung yield curves. A "total" photoabsorption cross section was obtained for each isotope by adding the partial cross sections together. Cross sections integrated to 40 MeV are given for each reaction. Giant resonance parameters obtained from the total cross sections are compared with the results of a dynamic collective model calculation. Cross section strength is found at energies above the giant dipole resonance and is discussed in terms of the integrated cross sections. (auth)

2006 ELASTIC SCATTERING OF ^{16}O BY EVEN MASS NICKEL ISOTOPES. West, L. Jr.; Kemper, K.W.; Fletcher, N.R. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 11: No. 3, 859-868 (Mar 1975).

The angular distributions of ^{16}O elastically scattered from enriched targets of even-mass nickel isotopes have been measured for $E_{^{16}O} = 36$ to 56 MeV. A four-parameter optical model is used to describe the data, and the parameter ambiguities are discussed in detail. A potential folding calculation provides an equally good representation of the data and yields a set of equivalent optical model parameters which are within the parameter ambiguity relationships discussed. The ^{16}O + nucleon real potential necessary to describe the data through the folding procedure is less than one-half the value derived from ^{16}O + nucleon scattering measurements. (auth)

2007 ABSOLUTE CROSS SECTIONS FOR THE ^{61}Ni(^{16}O, X) REACTIONS. Wells, J.C. Jr. (Tennessee Technological University, Cookeville, Tennessee 38501); Robinson, R.L.; Kim, H.J.; Ford, J.L.C. Jr. Phys. Rev. C 11: No. 3, 879-885 (Mar 1975).

The absolute cross sections for a number of different reactions resulting from the bombardment of ^{61}Ni with 38.5, 41.0, 43.5, 46.0, 48.5, and 51.0 MeV ^{16}O ions were determined from γ-ray yields observed from the decay of resulting radioactivities, and from yields of in-beam γ rays. The total cross section was compared to an optical-model calculation. The relative population of the reaction products was compared to calculations for the statistical decay of a compound nucleus by *n*, *p*, and α evaporation. This model does account for the general features of the experimental results, and agrees reasonably well with the stronger exit channels. (auth)

2008 ELASTIC SCATTERING OF ^{14}N BY ^{40}Ca, ^{56}Fe, ^{62}Ni, ^{70,74}Ge, ^{90}Zr, AND ^{118}Sn. Williams, M.E.; Davis, R.H.; Delaune, C.I.; Hudson, G.M.; Kemper, K.W. (Department of Physics, The Florida State University, Tallahassee, Florida 32306); Zeller, A.F. Phys. Rev. C 11: No. 3, 906-912 (Mar 1975).

Elastic scattering of ^{14}N by ^{40}Ca, ^{56}Fe, ^{62}Ni, ^{70,74}Ge, ^{90}Zr, and ^{118}Sn has been studied in the region of the Coulomb barrier in order to extract optical-model parameters and interaction barrier heights. Angular distributions were measured in 10° steps from 20° or 30° to 170° over an energy range of 24 to 54 MeV. Although barrier heights determined from the optical-model parameters were 20% lower than the static Coulomb barrier $Z_1Z_2e^2/1.35(A_1^{1/3} + A_2^{1/3})$, they are consistent with those calculated by several models. (auth)

2009 CORIOLIS COUPLING IN THE $g_{\frac{9}{2}}$ SHELL. Deleplanque, M. A.; Gerschel, C.; Perrin, N.; Ader, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides); Ishihara, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). J. Phys. (Paris), Lett.; 35: No. 12, L-237–L-238 (Dec 1974). (In French).

The levels of ^{77}Br have been studied by means of the reaction ^{75}As(α,2n,γ)^{77}Br at 28MeV. Evidence is given for the decoupling of the odd $g_{\frac{9}{2}}$ proton from the rotation of the core in ^{77}Br. Positive parity levels other than yrast ones are also discussed. The band built on the $\frac{3}{2}^-$ ground state is not decoupled. (FR)

2010 AVERAGE RESONANCE CAPTURE IN COBALT AND MANGANESE USING ^{10}B FILTER TECHNIQUE. Lopez, A. M. Hamilton, Ont.; McMaster Univ. (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

The high energy gamma rays from the radiative capture of ^{10}B filtered neutrons in ^{55}Mn and ^{59}Co were measured and analyzed in terms of the statistical and direct capture model of nuclear reactions. A high resolution NaI(Tl)-Ge(Li) pair spectrometer was used to detect the gamma rays. Correlations between (n,γ) and (d,p) intensities were determined for these nuclei. The distributions of the reduced intensities were also studied and compared with the predictions of the statistical model. Finally an attempt was made to determine a direct capture component in the ^{60}Co ground state partial cross section. It was found that the ground state data could be explained with the resonance amplitudes alone. The following amplitudes were deduced: $\Gamma^{\frac{1}{2}}_{132} = +0.109 \pm .001$ eV$^{\frac{1}{2}}$; $\Gamma^{\frac{1}{2}}_{4322} = +0.323 \pm .012$ eV$^{\frac{1}{2}}$; $\Gamma^{\frac{1}{2}}_{10700} = +0.232 \pm .020$ eV$^{\frac{1}{2}}$; $\Gamma^{\frac{1}{2}}_{16920} = 0.00094 \pm 0.102$ eV$^{\frac{1}{2}}$. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 804, 1851, 1961, 1965, 1968, 1977, 1984, 1992, 2000, 2008, 2057, 2060, 2074, 2092, 2100, 2102, 2105–2107, 2109, 2111, 2112, and 2117.

2011 (BNL-19787) MEASUREMENT OF 24.3 keV ACTIVATION CROSS SECTIONS WITH THE IRON FILTER TECHNIQUE. Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 3p. (CONF-750303-57). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

By using high-resolution detection techniques, intensities of specific activation lines from ^{197}Au(n,gamma), ^{238}U(n,gamma), ^{127}I(n,gamma), and ^{115}In(n,gamma) [54 min + 2.2 sec] were recorded by using the BNL HFBR iron-filtered neutron beam. From a comparison with the reaction ^{10}B(n,alphagamma), cross sections at 24.3 keV were determined. (24.3 keV neutron activation cross sections, relative ^{10}B standard). (4 figures) (auth)

2012 (COO-1779-155, pp 11-12) INELASTIC PROTON SCATTERING FROM ^{140}Ce AND ^{142}Nd AT Ep = 30 MeV. Rossner, H. H.; Austin, S. M. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2013 (COO-1779-155, pp 38-42) (p,n) REACTIONS IN ^{48}Ca, ^{90}Zr, ^{120}Sn, AND ^{208}Pb. Doering, R. R.; Galonsky, A.; Patterson, D. M. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2014 (COO-1779-155, pp 54-58) IN-BEAM GAMMA-RAY INVESTIGATIONS OF MEDIUM MASS ODD–ODD NUCLEI. Samuelson, L. E.; Morgan, C. B.; Slaughter, M. F.; Guile, J. A.; Warner, R. A.; McHarris, W. C.; Khoo, T. L.; Kelly, W. H.; Bernstein, E. M.; Shamu, R. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2015 (COO-1779-155, p 59) DECAY OF N = 79,81 NEUTRON DEFICIENT ODD–ODD RARE EARTHS. Firestone, R. B.; Warner, R. A.; Kosanke, K. L.; McHarris, W. C.; Kelly, W. H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2016 (COO-1779-155, pp 60-61) ϵ/β^+ AND DELAYED PROTON DECAY OF ^{143g,m}Gd. Firestone, R. B.; Warner, R. A.; Kosanke, K. L.; McHarris W. C.; Kelly, W. H. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2017 (JINR-P4-8286) E2-TRANSITIONS WITHOUT CHANGING THE PHONON NUMBER IN ^{108}Pd. Jolos, R. V.; Denau, F.; Kartavenko, V. G.; Janssen, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Experimental data on E2-transition probabilities in ^{108}Pd are analyzed. It is shown that by its properties ^{108}Pd differs from the spherical nuclei much more significantly than it was assumed by the models taking into account the anharmonic effects as small corrections. (auth)

2018 (RLO-2227-T7-23, pp 44-59) EXCITED STATES OF ^{128}Sb POPULATED IN THE β^- DECAY OF ^{128}Sn. Nunnelley, L. L.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2019 (RLO-2227-T7-23, pp 60-74) EXCITED STATES OF ^{130}Sb POPULATED IN THE β^- DECAY OF 3.7 MINUTE ^{130}Sn. Nunnelley, L. L.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2020 (RLO-2227-T7-23, pp 75-82) PROTON–NEUTRON HOLE STATES IN Sb ISOTOPES POPULATED IN THE β DECAY OF ^{128}Sn AND ^{130}Sn. Nunnelley, L. L.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2021 (UCID-16725) STATUS REPORT TO USNDC. Anderson, J. D.; Browne, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1975. 21p. Dep. NTIS $4.25.

This report to USNDC members and contributors contains brief reports on work in the following areas: standards, neutron data applications, nuclear data for safeguards, basic physics, and controlled thermonuclear research applications. Reports containing a significant amount of data are separately title listed. (6 figures) (RWR)

For title listings of individual papers see: 1919, 1938, 2022, and 2073.

2022 (UCID-16725, p 2) RECENT MEASUREMENTS OF THE ^{93}Nb(n,2n)/sup 92m/Nb (10.16d) CROSS SECTION. Nethaway, D. R. 11 Mar 1975.

In status report to USNDC.

2023 ANOMALOUS ϵ/β^+ DECAY BRANCHING RATIOS. Firestone, R. B. East Lansing, MI; Michigan State Univ. (1974). 207p. University Microfilms Order No. 75-7161.

Thesis (Ph. D.).

ϵ/β^+ decay branching ratios were measured for decays from ^{143}Eu, ^{143g}Sm, and ^{143g}Gd. $\gamma^{\pm}$–γ triple coincidence experiments were performed to get relative positron feedings to daughter levels. X–γ coincidence measurements were done for ^{145g}Gd decay to obtain relative electron capture feedings; these feedings were inferred from singles intensities for ^{143}Eu and ^{143g}Sm decay. The decay schemes of ^{143}Eu and ^{143g}Sm were also studied, and 12 levels were reported in ^{143}Pm as well as 16 levels in ^{143}Sm. Data were also gathered relevant to ^{140m}Pm decay and a β^+ endpoint for ^{66}Ga decay is reported. β decay theory is discussed in some detail, especially concerning the implications of ϵ/β^+ decay branching ratios. It is shown that anomalous ratios can only occur for higher-order terms in allowed transitions or if a pseudoscalar force is present. Neither possibility was hitherto eliminated experimentally. Among 15 measured ϵ/β^+ branching

ratios, two were significantly anomalous. The transition to the 808.5 keV level in ^{143}Eu was anomalous by a factor of 24 and the transition to the 1173.1 keV level in ^{143}Pm was anomalous by a factor of 4.9. Each case involved a similar hindered allowed transition and it was suggested that the higher-order allowed terms might be dominant in those instances. (Diss. Abstr. Int., B)

2024 STUDY OF THE FIVE STABLE (g,g) Mo-ISOTOPES WITH FAST NEUTRONS. Sinram, K. Hamburg; Univ. Hamburg (1973). 70p. (In German). INIS.

Thesis.

Gamma transitions from the reaction ^{100}Mo(n,n'γ)^{100}Mo were investigated. Over 50 transitions could be identified from which, with a few exceptions, a well-defined level and decay scheme was determined up to an excitation energy of 2.8 MeV. From the analysis of γ angular distributions, definite statements could be made for several levels about spin and parity. Also the measurement of differential effective cross sections for the elastic and inelastic scattering of neutrons on the five stable (even-even) isotopes ^{92}Mo to ^{100}Mo with neutron beam energies in the region of 2.5 to 3.5 MeV is described. The analysis of the differential effective cross-sections for the elastic scattering by means of the optical model together with the statistic theory for compound nuclear reactions, indicates a systematic dependence of the optical model parameter on the number of neutrons in the Mo isotopes. By comparing the differential effective cross-sections for the inelastic neutron scattering with calculations according to the statistic theory, low-excited 0^+ states could be found in all Mo isotopes investigated and for further levels several clear spin and parity assignments could be made. The results of the present work are compared in a concluding chapter with results from various investigations on excited states in the (even-even) Mo isotopes. (GE)

2025 DECAY OF 39.6 MIN ^{109}In AND 58 MIN ^{109m}In. Flanagna, S.; Chapman, R.; Dracoulis, G. D.; Durrell, J. L.; Gelletly, W.; Hartley, A. J.; Mo, J. N. (Univ. of Manchester, Eng.). J. Phys. G, Nucl. Phys.; 1: No. 1, 77-91(10 Jan 1975).

The γ rays emitted in the β^+/EC decay of 39.6 ± 0.7 min ^{109}In and 58.0 ± 1.2 min ^{109m}In have been studied in singles and coincidence with Ge(Li) detectors. Decay schemes for ^{109}In and ^{109m}In have been constructed. The results indicate that the spins and parities of ^{109}In and ^{109m}In are 3^+ and 5 or 6^+, respectively. This is discussed in terms of the j−j coupling model. The present knowledge of the properties of levels in ^{109}Cd is discussed. (auth)

2026 DIRECTIONAL CORRELATION MEASUREMENTS WITH THE γγ CASCADES FROM ^{131}Cs. Thielmann, R. Morburg, Ger.; Univ. Marburg (1972). 87p. (In German). INIS.

Thesis.

The decay of ^{131}Cs was investigated by directional correlation measurements of the (404-216), (832-216) and (247-373) keV γ-cascades using a fast two-parameter multichannel analyzer. From the measured results the spins of the excited states at 216 and 373 keV are found to be $J^\pi = 3/2^+$ and indicate the same spin assignment for the 1,048-keV state. The results furthermore enable limiting statements on the multipole mixed relations of the 216-, 404-, and 832-keV γ-transitions. (GE)

2027 EVIDENCE FOR THE PARTICLE-PLUS-ROTOR MODEL IN ^{133}La. Henry, E. A.; Meyer, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Z. Phys.; 271: No. 2, 75-78(Dec 1974).

The beta decay of the 5.4-hour isomer of ^{133}Ce to levels in ^{133}La has been studied using mass separated sources; a portion of the ^{133}La level scheme is presented. These experimental results are compared with calculations using an asymmetric particle-plus-rotor model. The good agreement between experiment and theory confirms the applicability of the particle-plus-rotor model with prolate deformation to the light lanthanum nuclei. (auth)

2028 HIGH-SPIN STATES IN ^{112}Cd FROM THE ^{110}Pd(α,2nγ)-REACTION. Geiger, R.; von Brentano, P.; Friedericha, H. G.; Heits, B.; Schuh, W.; Zell, K. O. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik); Weigmann, H. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements); Berinde, A. (Institutul de Fizica Atomica, Bucharest (Romania)). Z. Phys.; 271: No. 2, 129-137 (Dec 1974).

The decay scheme of ^{112}Cd has been studied by γ-ray spectroscopy with the ^{110}Pd(α,2nγ) reaction. Spin and parity assignments were made on the basis of coincidence measurements, angular distributions and excitation functions. Twelve new energy levels were established. A vibrational-like positive-parity band up to spin 8^+ and a negative-parity side band 5^-, (7^-), (9^-) were found. For the negative-parity states a $(\nu_j, \nu h_{11/2})$ configuration is suggested. (auth)

2029 EXCITED STATES IN ^{107}Ag FROM THE DECAY OF ^{107}Cd. Paradellis, T.; Kalfas, C. A. (Democritus Nuclear Research Center, Athens (Greece). Tandem Accelerator Lab.). Z. Phys.; 271: No. 2, 79-87(Dec 1974).

The decay of ^{107}Cd has been studied with Ge(Li) and Si(Li) detectors. Thirty-three gamma rays were observed in this decay, nine for the first time. Gamma-gamma directional correlation techniques employing a Ge(Li)-NaI(Tl) system were used to determine spins and mixing ratios. A decay scheme has been constructed with firmly established excited states at 93.13($7/2^+$), 125.4($5/2^+$), 324.8($3/2^-$), 423.0($5/2^-$), 786.7($5/2^-$), 922.1($5/2^+$), 949.7($5/2^-$), 972.9($7/2^-$, $3/2^-$), 1,143.0($5/2^-$), 1,223.0($5/2^+$), 1,258.8($5/2^-$), 1,325.7($5/2^-$) keV. A tentative level has been introduced at 1,389.8($7/2^+$) keV. The results are compared with the predictions of the theoretical calculations of Paar. (auth)

2030 LIFETIME AND MAGNETIC MOMENT OF THE $11/2^-$, 731 keV LEVEL IN ^{113}Sn. Dimmling, F.; Braeuer, N.; Focke, B.; Kornrumpf, T.; Nishiyama, K.; Riegel, D. (Freie Univ. Berlin (F. R. Germany). Fachbereich Physik). Z. Phys.; 271: No. 2, 103-105(Dec 1974).

The isomeric 731 keV, $11/2^-$ state in ^{113}Sn was populated by the reaction ^{113}In(p,n). The half life of the state was measured to be $T_{1/2}$ = 89(3) ns and the magnetic moment was determined by means of the pulsed beam PAD method as $\mu = -1.293(22)$ n.m. (auth)

2031 NUCLEAR SPECTROSCOPY AND REACTIONS. Part C. Cerny, J. (ed.). Pure and Applied Physics, Volume 40-C. New York; Academic Press, Inc. (1974). 516p.

Separate abstracts are prepared for the 13 chapters. (CES)

For abstracts of individual chapters see: 1776, 2032–2037, and 2087–2092.

2032 GAMMA RAYS FROM CAPTURE REACTIONS. Rolfs, C.; Litherland, A. E. (Univ. of Toronto). pp 143-184 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Various problems relating to the study of radiative capture reactions are considered, and a brief discussion of the necessary properties of the accelerators used and their energy calibration is given. A description of gamma ray detectors suitable for radiative capture studies is given, and problems involving selection and preparation of targets are discussed. Experimental and theoretical aspects of yield curves for capture reactions are outlined. Miscellaneous topics associated with capture reaction studies are discussed, and some of the problems illustrated. (SDF)

2033 DETAILED SPECTROSCOPY FROM FISSION. Cheifetz, E.; Wilhelmy, J. B. (Univ. of California, Berkeley). pp 229-276 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Spectroscopic measurements of prompt radiations from fission fragments prior to beta decay are discussed. Post beta decay de-excitation is examined for observations with high fission yield, short lived, prompt products. A comparison of the types of results obtained from prompt decay and beta decay is made in an attempt to demonstrate their complementary nature in giving nuclear structure information. Nuclear information obtained from spectroscopy of fission fragment products is summarized for various regions of interest. (14 figures, 2 tables, 113 references) (SDF)

2034 PHOTONUCLEAR REACTIONS. Berman, B. L. (Univ. of California, Livermore). pp 377-416 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Emphasis is placed on recent methods of photonuclear measurements that have been most fruitful, particularly photon production and neutron detection techniques. Experimental data pertaining to the giant dipole resonance and to the specification of properties of individual nuclear states near the particle thresholds are presented. The threshold photoneutron technique for studying nuclear states lying just above the neutron separation energy is discussed. Electromagnetic properties of levels below the particle thresholds are examined within the framework of photon scattering (resonance fluorescence). (21 figures, 200 references) (SDF)

2035 NUCLEAR SPECTROSCOPY FROM DELAYED PARTICLE EMISSION. Hardy, J. C. (Chalk River Nuclear Labs., Ont.). pp 417-466 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The physical principles governing the occurrence of beta delayed particle decay are generalized, and specific information that has been derived from it is discussed in detail. The related phenomenon of self-delayed particle decay (particle radioactivity) is mentioned. The discussion is mostly concerned with general spectroscopic properties shared by many nuclei and is restricted to nuclei with A less than 200. A brief description of specific questions of a more fundamental nature is included. (20 figures, 6 tables, 115 references) (SDF)

2036 EFFECTS OF EXTRANUCLEAR FIELDS ON NUCLEAR RADIATIONS. Shirley, D. A. (Univ. of California, Berkeley). pp 513-549 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The hyperfine Hamiltonian is introduced and the electromagnetic interaction of a nucleus with its environment is described in terms of nuclear moments coupling with extranuclear fields. The use of Moessbauer spectroscopy to determine equilibrium hfs parameters found in stable nuclei, relaxation effects, and interference effects is discussed. A brief examination of measurements that involve inner electronic shells of atoms is given. Experimental methods involving anisotropic angular distributions of radiation from prepared states, including perturbed angular correlations, nuclear orientation, and perturbed angular distributions are described. A brief treatment of resonance experiments and relaxation phenomena is provided. (9 figures, 1 table, 59 references) (SDF)

2037 GUIDE TO NUCLEAR COMPILATIONS. Ajzenberg-Selove, F. (Univ. of Pennsylvania, Philadelphia). pp 551-559 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

A selected list of reviews which contain useful nuclear data summaries or compilations is presented. (SDF)

2038 ROTATIONAL AND QUASIROTATIONAL BANDS IN EVEN-EVEN NUCLEI. Sayer, R. O. (Oak Ridge National Lab., TN); Smith, J. S. III; Milner, W. T. At. Data Nucl. Data Tables; 15: No. 2, 85-110(Feb 1975).

Presented here are experimental values of transition energies, level energies, and the computed quantities $2g/\text{Dirac constant}^2$ and $(\text{Dirac constant omega})^2$. The data cover 224 even-even nuclei from ^{20}Ne to ^{248}Cm. The literature cutoff date was May 1, 1974. (5 figures, 1 table) (auth)

2039 EXPERIMENTAL COULOMB DISPLACEMENT ENERGIES BETWEEN ANALOG ENERGY LEVELS OF ISOBARIC NUCLEI WITH A EQUALS 3 TO A EQUALS 238. Courtney, W. J.; Fox, J. D. (Univ. of Florida, Tallahassee). At. Data Nucl. Data Tables; 15: No. 2, 141-187(Feb 1975).

Presented here is a summary of the literature, up to January 31, 1974, on the excitation energies of analog energy levels in isobaric nuclei with A equals 3 to A equals 238. The summary was prepared to provide up-to-date values of the Coulomb displacement energies between accessible members of isospin multiplets. The results are presented in tabular form. (auth)

2040 NUCLEAR CHARGE- AND MAGNETIZATION-DENSITY-DISTRIBUTION PARAMETERS FROM ELASTIC ELECTRON SCATTERING. de Jager, C. W.; de Vries, H.; de Vries, C. (Instituut voor Kernphysisch Onderzoek, Amsterdam). At. Data Nucl. Data Tables; 14: No. 5-5, 479-508(1974).

A compilation of nuclear charge- and magnetization-density-distribution parameters, found from elastic electron scattering, is presented. The data on charge distributions, obtained on the basis of a phenomenological model, are given in three separate tables: parameters of nuclei, differences therein between isotopes and between other neighboring nuclei such as isotones. A fourth table is devoted to charge distributions obtained by model-independent analyses. In the final table the available data on magnetization-density distributions are listed. References through April 1974 have been covered. (auth)

2041 $\beta-\gamma$ DIRECTIONAL CORRELATION OF ^{148}Pm. Drehmann, P. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Strahlenphysik). Z. Phys.; 271: No. 4, 349-351(Dec 1974). (In German).

A measurement of the $\beta-\gamma$ directional correlation $\omega(W\theta)$ of the $3^-(\beta)2^+(\gamma)0^+$ decay of ^{148}Pm is described. Spin and parity of the ground state of ^{148}Pm are found to be 3^-. A set of matrix elements $Y = 0.94$; $x = 0.20$; $u = 0.20$; $z = 1$, which is chosen to fit the experimental results for $\omega(W,\theta)$ and which is in agreement with the CVC theory, indicates a K-selection rule effect for the 0.795 MeV beta transition of ^{148}Pm. (auth)

2042 LEVELS AND TRANSITIONS IN ^{126}Te. Bargholtz, C.; Becker, J.; Beshai, S.; Eriksson, L.; Fransson, K.; Gidefeldt, L.; Holmberg, L.; Stefansson, V. (Stockholm Univ. (Sweden). Fysiska Institutionen). Z. Phys.; 272A: No. 1, 4-11(1975).

The decay of ^{126}Sb to ^{126}Te is studied by use of Ge(Li) detectors in singles and coincidence arrangements. The gamma-gamma directional correlations of six cascades are measured. A level scheme is constructed where all transitions observed are located. The characteristics of several of the levels are assigned, on basis of the log ft values deduced and the directional correlation results. Mixing ratios are deduced for three transitions. From the comparison of the relative intensities of E1 and E2 transitions depopulating the same levels, three E1 transitions are concluded to be strongly retarded. (auth)

2043 STATES IN $N = 81$ ^{141}Nd POPULATED BY THE DECAY OF ^{141}Pm. Yap, F.Y.; Todd, R.R.; Kelly, W.H. (Cyclotron Laboratory and Department of Physics, Michigan State University, East Lansing, Michigan 48824); McHarris, W.C.; Warner, R.A. Phys. Rev. C 11: No. 3, 952-965 (Mar 1975).

The decay of 20.90-min ^{141}Pm has been studied with Ge(Li) and NaI(Tl) γ-ray detectors in a variety of singles and coincidence configurations, including Ge(Li) -Ge(Li) two-parameter "megachannel" coincidence experiments, anticoincidence experiments, and pair $(\gamma^*-\gamma)$ experiments to determine the relative β^+ feedings. Fifty-two γ rays were identified from this decay, and 43 of these (> 99% of the γ intensity) were placed in a decay scheme containing 23 levels in ^{141}Nd. J^π assignments or limits were made for all of the states. The structures of the lower-lying states in ^{141}Nd are discussed in terms of the shell model, and possible structures are also suggested for many of the higher-lying states. We compare our results with those of previous studies and also with particle-transfer data. (auth)

2044 LIFETIMES OF LEVELS IN ^{136}Xe, ^{140}Cs, AND ^{141}Cs POPULATED IN THE DECAYS OF MASS-SEPARATED ^{136}I, ^{140}Xe, AND ^{141}Xe. Morman, J.A.; Schick, W.C. Jr.; Talbert, W.L. Jr. (Ames Laboratory-U. S. Atomic Energy Commission and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. C 11: No. 3, 913-919 (Mar 1975).

The decays of ^{141}Xe, ^{140}Xe, and ^{136}I were examined for the presence of energy levels in ^{141}Cs, ^{140}Cs, and ^{136}Xe, respectively, with measurable half-lives in the nsec range. Using a least-squares fitting procedure to analyze the delayed coincidence data taken with a planar Ge(Li) -plastic scintillator system, the half-lives of the following levels were measured: ^{141}Cs: 69.0 keV, 23.3±0.7 nsec; 105.9 keV, 8.7±0.2 nsec, ^{140}Cs: 13.9 keV, 471±51 nsec; 64.7 keV, 3.7±0.3 nsec, 103.1 keV, 7.3±0.3 nsec (average of two measurements). In addition, upper limits for the half-lives of other levels in these two isotopes are also given, as well as for some levels in ^{136}Xe. Possible multipolarities of the transitions are discussed. (auth)

2045 RADIOACTIVE DECAY OF 4.4-h ^{105}Ru TO LEVELS OF ^{105}Rh. Aras, N.K.; Walters, W.B. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). Phys. Rev. C 11: No. 3, 927-938 (Mar 1975).

The energies, intensities and coincidences of the γ rays following the radioactive decay of 4.4-h ^{105}Ru to levels of ^{105}Rh have been determined. 85 γ rays have been fit into a level scheme between 25 excited states. Spin and parity assignments are deduced and discussed as are the results of earlier ^{104}Ru(^{3}He, d)^{105}Rh and ^{108}Pd(p, α)^{105}Rh reaction studies. The level structure of ^{105}Rh is compared with other odd-mass $41 \leq Z \leq 49$ nuclides, and the presence of strong $E1$-$M1$/$E2$ competition, discussed. (auth)

2046 DIRECTIONAL CORRELATIONS OF GAMMA RAYS IN ^{131}I. Ludington, M.A. (Physics Department, Albion College, Albion, Michigan 49224); Gardulski, P.L.; Wiedenbeck, M.L. Phys. Rev. C 11: No. 3, 987-990 (Mar 1975).

The γ radiation following the decay of ^{131}Te^m to levels in ^{131}I has been studied. γ-γ directional correlation measurements have been made using two Ge(Li) detectors. The amplitude mixing ratios for 11 transitions have been determined. A discussion of possible spin assignments for several of the levels is presented. (auth)

2047 NUCLEAR STRUCTURE STUDIES WITH (d, t) REACTIONS ON ^{110}Cd. Chan, K.C.; Cohen, B.L.; Shabason, L. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 11: No. 3, 1064-1066 (Mar 1975).

Discrepancies between the energy level schemes of ^{109}Cd determined by radioactive decay studies and ^{110}Cd(d, t) reaction studies were investigated by a new study of the ^{110}Cd(d, t) reaction. Sixteen triton groups were found, J^π assignments were made, and spectroscopic factors and fullnesses of single-particle states were determined and compared with those for isotonic nuclei. The results remove or clarify all previous discrepancies. (auth)

2048 CAPTURE GAMMA RAYS FROM HIGH-SPIN STATES EXCITED BY THERMAL-NEUTRON CAPTURE IN NUCLEAR ISOMERS. Hamermesh, B. (Department of Physics, Cleveland State University, Cleveland, Ohio 44115); Smither, R.K. Phys. Rev. C 11: No. 3, 827-828 (Mar 1975).

Thermal-neutron-capture γ rays from ^{123}Te^m were studied in the energy region 6.7 to 9.5 MeV. The capturing nucleus has spin $h_{11/2}$- so that states of spin 5- and 6- may be reached. Transitions to states of ^{124}Te having spins 6+ and 7- were observed, whereas transitions to a low-lying state of spin 4+ were not observed. The results indicate that the 6- state is excited by capture, whereas the 5- state is not. The technique used provides a method of studying high-spin states. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 893, 1965, 1984, 2014, 2033, 2038, and 2114.

2049 (COO-1779-155, pp 32-33) MULTISTEP PROCESSES IN $^{186}W(p,d)^{185}W$. King, C. H.; Bernthal, F. M.; Khoo, T. L.; Nolen, J. A. Jr.; Creasy, J. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

2050 (COO-1779-155, pp 70-1) LEVELS IN ^{182}W. Jeltema, B. D.; Bernthal, F. M.; Khoo, T. L.; Dors, C. L. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

2051 (COO-1779-155, pp 72-73) ROTATIONAL BANDS IN ^{183}Os. Dors, C.; Bernthal, F. M.; Warner, R. A. Sep 1974.
In annual report, July 1, 1973–July 1, 1974.

2052 INVESTIGATIONS TO THE MECHANISM OF HIGH ENERGY NUCLEAR REACTION. Compact. Ross, E. Darmstadt, Ger.; Technische Univ. (1972). 4p. (In German). INIS.
Thesis.
An attempt was made to investigate the reaction of complex nuclei with high-energy protons. By using the DIT method, effective cross sections, average ranges and F/B values for products were determined by γ spectrometry, which were produced by the reaction of tantalum nuclei with protons of energy 0.3 GeV or 19.2 GeV as well as by the reaction of gold nuclei with protons of 0.58 GeV energy. The average kinetic energies and the average pulses of the products, as well as the average excitation energies of the starting nuclei were calculated from the measured values. Furthermore, together with effective cross sections determined in this work and with the help of values taken from the literature, a semi-empirical equation has been derived for the effective cross section of spallation products. (GE)

2053 ASYMMETRY EFFECT IN THE CRANKING APPROACH TO HIGH-SPIN ROTATIONAL STATES IN STRONGLY DEFORMED NUCLEI. Lin, L.; Dreizler, R. M. (Univ., Frankfurt am Main). Lett. Nuovo Cim.; 12: No. 12, 444-446 (22 Mar 1975).
From a simple reinvestigation of asymmetry in the cranking approach, the high spin states (including the asymmetry effect and the state-dependent pairing potential) are studied with the required projections. The description is based on the simplified HFB method. The moment of inertia is calculated for neutrons in ^{168}Yb. It is concluded that there is indeed a significant microscopic asymmetry effect caused directly by Coriolis antipairing of a rotating system. (JFP)

2054 ATOMIC BEAM RESONANCE INVESTIGATION OF THE GROUND STATE $^3F_2$ OF HAFNIUM AND MEASUREMENT OF THE NUCLEAR MAGNETIC DIPOLE MOMENTS OF ^{177}Hf AND ^{179}Hf. Buettgenbach, S. Bonn; Univ. Bonn (1973). 67p. (In German). INIS.
Thesis.
The ground state $^3F_2$ of hafnium has been investigated with the atomic beam resonance method. The following were individually investigated: the g(J)-factor on the ^{180}Hf isotope, the hyperfine structure distances of the isotopes ^{177}Hf and ^{179}Hf and the g(I)-factors of ^{177}Hf and ^{179}Hf. The subsequent values for the magnetic nuclear dipole moments of the nuclear ground state of both isotopes were determined from the above: $\mu(^{177}Hf) = 0.7836$ (6) $\mu(N)$ and $\mu(^{179}Hf) = -0.6329$ (13) $\mu(N)$. (GE)

2055 NUCLEAR DATA SHEETS FOR A EQUALS 166. Buyrn, A. (Massachusetts Inst. of Tech., Cambridge). Nucl. Data Sheets; 14: No. 4, 471-588(Apr 1975).
Nuclear structure data for mass-166 nuclei are compiled, and adopted level and gamma-ray properties are presented. The adopted values are based on all data received before May 1974. All published data received between May and August 1974 were also considered in arriving at adopted values. (auth)

2056 EVIDENCE FOR A WEAK β BRANCH IN THE DECAY OF THE NATURALLY OCCURRING NUCLIDE ^{176}Lu. Ardisson, G. (Univ., Algiers, Algeria). Radiochem. Radioanal. Lett.; 20: No. 6, 363-369(20 Mar 1975). (In French).
Radioactive decay of the odd–odd nucleus ^{176}Lu was reinvestigated by using Ge(Li) detectors and γγ coincidences. A new 401.4-keV γ ray was observed; it was interpreted as a $8^+ \rightarrow 6^+$ transition in ^{176}Hf. Rotational parameters in the ^{176}Hf ground-state band were calculated. The log ft value for this new β branch was calculated, and it was in good agreement with the theoretical prediction. (2 figures, 1 table) (auth)

2057 STRUKTURA CHETNYKH DEFORMIROVANNYKH YADER. (Structure of Even, Deformed Nuclei). Grigor'ev, E. P. Moscow; Izdatel'stvo Nauka (1974). 303p.
The monograph presents the principles of the present-day theory of deformed nuclei. A description is given of the average field of a deformed nucleus in the form of axially-symmetric Nilsson and Saxon–Woods potentials. A demonstration is given of the important role of pairing correlations of the superconducting type in describing the properties of atomic nuclei. A semimicroscopic theory of nuclear vibrations is given. A large body of experimental material on deformed nuclei in the region $150 < A < 190$ is reviewed critically. As a result of the analysis a selection is made of the most complete, reliable and accurate data characterizing the low-lying (up to 2 to 3 MeV) states of even–even, deformed nuclei. This information is presented in the form of diagrams for identified levels, and in the form of tables for other states. In many cases the analysis performed in the monograph goes beyond the framework present in the original literature. Systematization of the energies of excited states and of the reduced probabilities of β and γ transitions is carried out. A presentation is given of the results of calculating the energies and wave functions of two-quasi-particle and single-phonon states, and a comparison of theory with experiment is performed. The monograph clearly demonstrates the success of nuclear theory in describing the structure of deformed nuclei. The monograph also predicts the properties of excited states of even–even, deformed nuclei. These predictions can serve as a starting point for further experimental studies. (96 figures, 80 tables, 507 references) (tr-auth)

2058 COEXISTENCE AND MIXING OF SPHERICAL AND DEFORMED STATES IN THE REGION OF LIGHT Hg-ISOTOPES. Dickmann, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik); Dietrich, K. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department, Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Z. Phys.; 271: No. 4, 417-426 (Dec 1974).
The low-energy spectra of ^{188}Hg and ^{184}Hg are interpreted by a mixing of spherical and deformed states for angular momentum $I = 2.4$. In order to establish agreement between experimental results on ^{186}Hg and ^{184}Hg and potential calculations, a stronger isospin dependence of the pairing interaction is introduced. The existence of shape-isomeric states for ^{186}Hg, ^{184}Hg with a lifetime approximately 10^{-9} sec is concluded from the model. The particle-vibration coupling is discussed as the probable origin for the odd-even staggering of the ground-state deformation. (auth)

2059 LEVELS IN ^{158}Dy AS POPULATED FROM DECAY OF ^{158}Ho IN EQUILIBRIUM WITH 2.3-h ^{158}Er. Ruth, T.J.; Brenner, D.S. (Jeppson Laboratory, Clark University, Worcester, Massachusetts 01610). Phys. Rev. C 11: No. 3, 974-986 (Mar 1975).
The γ-ray spectrum of the decay of ^{158}Ho in transient equilibrium with 2.3-h ^{158}Er has been studied with Ge(Li) detectors. Results of γ-ray singles and coincidence experiments are reported, and a decay scheme for $^{158}Ho \rightarrow {}^{158}Dy$ is proposed. New levels have been assigned to the β-vibrational band and a rotational band built on the two-quasineutron state ($\nu 5/2^-[523] + \nu 3/2^-[521]$). A new $K = 2$ rotational band with spins up to 6^+ built on a level at 1851.9 keV is proposed. An attempt is made to characterize a group of negative-parity states at about 1400 keV, and tentative assignments of the $K = 0$, 1, and 2 octupole vibrational band heads are suggested. (auth)

2060 TOTAL NEUTRON CROSS SECTION FOR ^{151}Sm AND NUCLEAR SYSTEMATICS OF THE Sm ISOTOPES. Kirouac, G.J.; Eiland, H.M. (Knolls Atomic Power Laboratory, Schenectady, New York). Phys. Rev. C 11: No. 3, 895-905 (Mar 1975).
The energy-dependent total neutron cross section of ^{151}Sm, a fission product poison, has been measured from thermal neutron energies up to about 2.3 keV. The results obtained for the thermal (0.0253 eV) cross section, resonance integral, *s*-wave level spacing, and strength function were 15 200 ± 300 b, 3520 ± 160 b, 1.72 ± 0.07 eV, and $S_0 = 3.65 \pm 0.48 \times 10^{-4}$, respectively. The neutron widths for 120 resonances up to 300 eV were obtained by conventional analytic methods, and the radiation widths were also obtained for 13 low-energy resonances. The strength function was derived from resolved neutron resonances and from the average keV cross section. In addition, the Dyson-Mehta Δ_3 statistic was calculated from the level sequences of six Sm isotopes and compared with the prediction of the statistical orthogonal ensemble. The level densities of six Sm isotopes and seven Nd isotopes were used to compute the Fermi level density parameter *a*, and these results are discussed in light of the nuclear structure. Finally, the systematic behavior of *s*-wave strength functions in the $142 \leq A \leq 158$ mass region is examined. (auth)

2061 A NUCLEUS FAR FROM STABILITY: ^{182}Pt. Cailliau, M.; Foucher, R.; Husson, J. P.; Letessier, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). J. Phys. (Paris), Lett.; 35: No. 12, L-233–L-236(Dec 1974). (In French).

The ^{182}Pt nucleus is studied by conversion electron and gamma on-line spectroscopy from the decay of ^{182}Au($T_{\frac{1}{2}}$ = 22.1 ± 1.3s) using the ISOLDE facilities. A partial level scheme is discussed. (FR)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 1984, 1992, 2011, 2013, 2038, 2039, 2052, 2057, 2072, 2078, 2117, and 2118.

2062 (COO-1779-155, p 74) HIGH SPIN LEVEL STRUCTURE IN Pt NUCLEI FROM Os(α,x$n\gamma$) REACTIONS. Cunnane, J. C.; Piiparinen, M.; Daly, P. J.; Bernthal, F. M.; Dors, C. L.; Khoo, T. L. Sep 1974.

In annual report, July 1, 1973–July 1, 1974.

2063 OBSERVATION OF INTERNAL PAIR FORMATION IN ^{200}Hg AFTER NEUTRON CAPTURE. Schumann, S.; Waldschmidt, M. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 271: No. 2, 97-101(Dec 1974). (In German).

4 figs.; 1 tab.; 10 refs. Also issued as AED-CONF-74-044-010.

The electron spectrum of ^{200}Hg, excited by slow neutron capture, has been measured by means of the superconducting conversion electron analyzer SULEIKA up to 7 MeV at the research reactor Muenchen-Garching. 50 transitions, ensuing by internal pair formation, have been observed by analyzing sum pulses from one detector with respect to their pulse height. A new method for discriminating these peaks from those of internal conversion was used. Estimating the transmission of the spectrometer coefficients of internal pair production were determined. (auth)

2064 LEVELS OF ^{203,205}Tl FROM THE (n, $n'\gamma$) REACTION. Ahmed, N.; Gill, D.R.; McDonald, W.J.; Neilson, G.C.; Dawson, W.K. (Nuclear Research Centre, The University of Alberta, Edmonton, Alberta, Canada). Phys. Rev. C 11: No. 3, 869-878 (Mar 1975).

The energy levels of ^{203}Tl and ^{205}Tl have been studied using the (n, $n'\gamma$) reaction with enriched isotopes. Deexcitation γ rays were observed in a time-of-flight gated Ge(Li) detector at several neutron energies. Level schemes for ^{203}Tl and ^{205}Tl have been proposed. A substantial discrepancy between the experimental cross sections and those calculated from the compound nuclear statistical theory has been found. The magnitudes of the predicted cross sections are roughly a factor of 2 high, whereas previous results for other nuclei indicate much better agreement. (auth)

2065 ^{206}Pb(p, d)^{205}Pb REACTION, ENERGY-WEIGHTED SUM RULE, SHELL MODEL TEST. Lanford, W.A. (Wright Nuclear Structure Laboratory, Department of Physics, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 11: No. 3, 815-826 (Mar 1975)

The ^{206}Pb(p, d)^{205}Pb reaction has been studied at 35 MeV. The angular distributions for this reaction were measured relative to the angular distributions for the ^{208}Pb(p, d)^{207}Pb reaction to the single-neutron-hole states in ^{207}Pb and relative spectroscopic factors are reported. The non-energy-weighted sum rule is used to determine the orbit occupancies of the ^{206}Pb target. These orbit occupancies are combined with other experimental results to determine the ground state wave function of ^{206}Pb. The Bansal-French energy-weighted sum rule is used to deduce some properties of the neutron-neutron effective interaction. Detailed comparison between experimental spectroscopic factors and predictions of recent nuclear model calculations is made. (auth)

2066 ANGULAR DISTRIBUTIONS OF THRESHOLD PHOTONEUTRONS FROM ^{208}Pb. Haacke, L. C. Toronto; Univ. of Toronto (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

A detector of neutrons in the energy region from 0 to 2000 keV was designed and fabricated for use in a neutron time-of-flight spectrometer. This detector employs two optically isolated 4½" diameter by ½" thick pieces of ^{6}Li-loaded glass scintillator arranged in tandem, and features circuitry for detector gating. Two independent fast output pulses suitable for fast timing purposes, and a third output pulse suitable for pulse-height discrimination purposes are available from each half of the detector. Background was reduced in this work by demanding coincidence of these three outputs. Bremsstrahlung produced with the aid of a 10 MeV electron beam from the University of Toronto Linac was used to irradiate a sample of natural lead, and time-of-flight spectra of photoneutrons from the lead sample were measured at five angles relative to the incident photons. Angular distributions for fourteen ^{208}Pb resonances observed within 900 keV of threshold in these spectra were calculated by normalizing resonance yields to the yield from a known s-wave resonance present in the spectra. An anomalous concentration of M1 strength so determined in the data confirms the existence of an M1 giant resonance. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 146, 155, 2011, 2038, 2039, 2114, and 2121.

2067 (AED-CONF-74-306-003) SUPERHEAVY QUASIMOLECULES. Mekler, P. H.; Hagmann, S.; Armbruster, P.; Kraft, G.; Stein, H. J.; Rashid, K.; Fricke, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). 1974. 24p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

14 figs.; 1 tab.; 34 refs.

The noncharacteristic radiation from extremely heavy collision systems as, e.g., I → Au is discussed. Main emphasis is given to the quasimolecular M radiation. In this case, experiments and theory indicate even quasiatomic radiation. Quasimolecular L and K radiations are only summarized very briefly. (auth)

2068 (CRN-PN-74-6) STUDY OF BINARY AND TERNARY FISSION OF URANIUM AND LEAD NUCLEI INDUCED BY PROTONS IN THE ENERGY RANGE FROM 0.6 TO 23 GeV. Remy, G. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1974. 171p. (In French). INIS.

The specific advantages of a visual threshold detector, the Makrofol, are used to study the multiplicities of the heavy fragment production ($A \gtrsim 25$) in the interactions of high energy protons with fissible targets. It is shown that for proton energies above 0.6 GeV, there is a competition between 2 distinct disintegration channels: the classical fission of the recoil nucleus into 2 fragments, a process of which the cross section decreases exponentially like from 0.6 GeV, and consequently a typically low energy mechanism and the disintegration of the recoiling nucleus into 3 fragments (eventually more than 3 fragments), one of them being preferentially very light ($A \lesssim 25$), and whose cross section, marked by a threshold near 0.6 GeV is characteristic of a specific high energy mechanism. The comparison of the present results with radiochemical data permits one to conclude to a double correspondence between: binary fission in flight and the production of pairs of heavy neutron-rich fragments and the ternary disintegration process and the production of very light fragments in correlation with pairs of heavy neutron-poor fragments. This is the first experimental evidence permitting one to assign a defined disintegration scheme to the fragmentation phenomenon. This conclusion is also supported by the results of the kinematical approach analysis of the ternary events detected ($A \gtrsim 25$), which are in satisfactory agreement with the radiochemical recoil data of fragmentation products. (auth)

2069 (GFK-LTA-0437) SEARCH OF TRANSURANIC ELEMENTS. Methods, Results and Perspectives. Zhdanov, G. B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Literaturabteilung). 1973. 69p. (In German). INIS.

Published in Usp. Fiz. Nauk., v. 111(1), 1973, p. 109-137.

Experiments to detect nuclei ($Z \geq 116$) with accelerators and under natural conditions are described. Investigation methods of the cosmic radiation regarding heavy elements and the results are discussed in great detail and considerations for the planning of new experiments are made. (GE)

2070 (RLO-2227-T7-23, pp 4-30) STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H. R.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2071 (RLO-2227-T7-23, pp 31-37) STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{235}U. Bouchard, S. M.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2072 (RLO-2227-T7-23, pp 41-43) SEARCH FOR C ION RADIOACTIVITY IN HEAVY ELEMENTS. Bouchard, S. M.; Loveland, W. Sep 1974.

In Oregon State University nuclear chemistry progress report during the period March 15, 1973–September 15, 1974.

2073 (UCID-16725, p 2) FISSION NU-BAR MEASUREMENTS. Howe, R. E.; Phillips, T. W. 11 Mar 1975.
In status report to USNDC.

2074 INVESTIGATIONS ON A CONVERSION ELECTRON EXPERIMENT WITH PRIMARY FRAGMENTS FROM THE FISSION OF ^{238}U BY THERMAL NEUTRONS. Hofmann, D. Frankfurt am Main; Univ. Frankfurt am Main (1973). 68p. (In German). INIS.
Thesis.
Experiments are described to spectrometrically detect the conversion electrons emitted from the fission fragments of ^{238}U and to assign the fragment mass. Such an evaluation of the data is carried out in detail for the fragment ^{144}Ba. (GE)

2075 ODD-EVEN SYSTEMATICS IN NEUTRON FISSION YIELDS OF ^{233}U AND ^{235}U. Amiel, S.; Feldstein, H. (Soreq Nuclear Research Centre, Yavne, Israel). Phys. Rev. C 11: No. 3, 845-858 (Mar 1975).
An analysis of the distribution of independent yields in neutron-induced fission of ^{233}U and ^{235}U revealed a constant enhancement of products with an even number of protons, relative to those with an odd number. This odd-even effect in the proton pairing, related to calculated "normal" yields of elements in fission, constitutes a sawtooth structure with an amplitude of (22±7) % for both ^{233}U and ^{235}U thermal-neutron-induced fission. The residual neutron pairing effect evident after the emission of prompt neutrons, while it is insignificant (< 3%) in the light-mass peaks, is partly preserved in the heavy-mass peaks of both ^{235}U and ^{233}U thermal neutron fission products. Its average magnitude is about (8±5) % relative to the "normal" distribution of isotonic yields. In the fission of ^{235}U with fission spectrum neutrons, the proton pairing effect drops to (8±4) %. The odd-even effect is discussed in view of the various mass splits, the excitation energy and potential energy surfaces in the descent from the saddle to the scission configuration. (auth)

2076 SHELL AND PAIRING EFFECTS IN ALPHA-ACCOMPANIED FISSION. Cârjan, N.; Săndulescu, S. (Institut für Kernphysik der Technischen Hochschule Darmstadt, Germany); Pashkevich, V.V. Phys. Rev. C 11: No. 3, 782-788 (Mar 1975).
Supposing that an α emitter remains an α emitter while it undergoes fission, the α-particle formation probability on the surface of the fissioning system is computed (at different moments of spontaneous fission of ^{252}Cf and thermal neutron fission of ^{235}U) in the point-α-particle approximation and within the shell model, the Woods-Saxon nucleonic configurations being mixed through pairing forces. The variation with position on the surface is given. The results obtained afford a qualitative explanation of the experimental angular distribution (including polar emission) of α particles accompanying the fission process. (auth)

2077 TRANSITION FROM MASS ASYMMETRY TO SYMMETRY IN THE SPONTANEOUS FISSION OF Fm ISOTOPES. Mustafa, M.G. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. C 11: No. 3, 1059-1063 (Mar 1975).
The observed transition in the spontaneous fission mass distribution from asymmetry in the lighter Fm isotopes to symmetry in the heavier Fm isotopes is studied on the basis of the potential energy surfaces (PES) and fragment shell effects in the two-center shell model. To that end, we have calculated the PES for ^{256}Fm and compared them with our previous PES results for other Fm isotopes. Our calculations show that the lighter Fm isotopes (up to ^{256}Fm) should fission asymmetrically, while ^{258}Fm and other heavier Fm isotopes should fission symmetrically. This is due to the fact that the shell corrections in these nuclei are found to increase with increasing mass number and decreasing neck radius, particularly in the region beyond the second barrier. This, in turn, is a consequence of strong shell effects in fragment nuclei near the doubly closed-shell $^{132}_{50}Sn_{82}$. The results supporting these conclusions are shown. (auth)

2078 SYNTHESIS OF NEUTRON-DEFICIENT ISOTOPES OF FERMIUM, KURCHATOVIUM, AND ELEMENT 106. Oganesyan, Yu. Ts.; Tret'yakov, Yu. P.; Il'inov, A. S.; Demin, A. G.; Pleve, A. A.; Tret'yakova, S. P.; Plotko, V. M.; Ivanov, M. P.; Danilov, N. A.; Korotkin, Yu. S.; Flerov, G. N. (Joint Institute for Nuclear Research). JETP Lett. 20: No. 8, 265-266(20 Oct 1974).
We have measured the cross sections for the production of ^{244}Fm, ^{246}Fm, ^{253}Ku, ^{256}Ku, ^{259}106 using compound-nucleus reactions. Various isotopes of lead were used as targets, and beams of ^{40}Ar, ^{50}Ti, and ^{54}Cr were employed. (AIP)

2079 PHOTOFISSION OF ^{238}U BELOW THRESHOLD. Bhandari, B. S. Athens, OH; Ohio Univ. (1974). 277p. University Microfilms Order No. 75-3546.
Thesis (Ph.D.).
The purpose of this investigation is to examine the process of photofission in ^{238}U near and below threshold. The absolute photofission cross section of ^{238}U is known to have peaks at 5.2, 5.7, 6.2, 7.1, and 7.8 MeV of gamma energy. It is difficult to understand the existence of such structure in terms of liquid drop model with a single humped barrier against fission with respect to nuclear deformation. However, Strutinsky has recently suggested the existence of a double humped barrier in fission which has an additional potential minimum called the "second well" and it appears possible that the above noted resonance structure can possibly be explained in terms of quasi stable states formed in this second well. A detailed study of penetration through a double humped barrier has been made. A model calculation has been performed within the framework of quasi-classical approximation for a potential barrier which also includes the primary potential well of the bound nucleus. Photofission cross sections have been calculated and an attempt has been made to reconcile the apparent resonance structure observed in photofission experiments and the isomeric and ground state spontaneous fission halflives in terms of a single suitable set of parameters of a double humped barrier for ^{238}U. The results indicate that fission halflives and resonances in photofission cross sections near threshold are satisfactorily reproduced. Our calculation also predicts several low energy resonances in photofission cross sections of ^{238}U. (LBS)

2080 HEXADECAPOLE DEFORMATION AND ASYMMETRIC SPONTANEOUS FISSION OF ACTINIDES. Stocker, W. (Univ., Munich). Lett. Nuovo Cim.; 12: 459-462(22 Mar 1975).
In this investigation a model is proposed which relates the well known decrease of fission mass yield asymmetry in the actinide group to the parallel decrease of the hexadecapole deformation. A statistical analysis is prescribed for the uranium-235 spontaneous fission mass yield curve in order to obtain the cluster sizes. (JFP)

2081 ASSESSMENT OF ENDF/B-III DATA FOR URANIUM-238 BASED ON INTEGRAL SPECTRUM MEASUREMENTS. Becker, M.; Kaushal, N. N. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 56: No. 3, 307-309(Mar 1975).
Neutron spectra in uranium depleted in the ^{235}U isotope are analyzed with ENDF/B-III data, accounting for high-order anisotropic scattering. Two principal conclusions are made. First, changes made to inelastic scattering data relative to earlier ENDF/B files are not effective in reducing discrepancies between calculated and measured spectra. Second, changes made to unresolved capture data lead to significant improvement in the relation between calculation and experiment. (auth)

Nuclear Theory

Refer also to abstracts 1792, 1794, 1836, 1848, 1950, and 2023.

2082 (IAE-2319) TWO-LEVEL MODEL FOR THE ROTATION OF A NUCLEUS WITH GREAT MOMENTUM. Pavlichenkov, I. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii). 1973. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.
A model system of nucleons is considered which permits the study of physical phenomena originating in the rotational spectra of deformed nuclei with large momentum. It is shown that it is possible to explain the typical S-shaped curve of the dependence of the moment of inertia of the system on the square of the frequency of rotation by the occurrence of a metastable state in the rotating system of coordinates. A detailed investigation of this state is made, and the domain of its existence is derived. (tr-auth)

2083 EIKONAL-APPROXIMATION TO CALCULATE DISPERSION-CORRECTIONS FOR ELASTIC NUCLEAR SCATTERING AT HIGH ELECTRON ENERGIES. Rosenfelder, R. Freiburg i.B; Univ. Freiburg i.B (1973). 81p. (In German). INIS.
Thesis.
The virtual excitation of the nucleus in elastic scattering of high-energy electrons is described by complex additional scattering phases which are calculated for a given nuclear model with the eikonal approximation. A description by an energy-independent optical potential is equivalent. The total inelastic cross-sections calculated with the imaginary part of the additional phases are in good agreement with the experimental evaluations. (GB)

2084 NEUTRON-TO-PROTON RATIO ON THE SURFACE OF HEAVY NUCLEI. Goel, S. P. (Kurukshetra Univ., India); Prakash, Y. Czech. J. Phys.; B25: No. 2, 150-154(1975).
The results of a computer simulation study of K^- capture in emulsion nuclei are used to reappraise experimental data pertaining to the question of the existence of a "neutron halo" on the surface of heavy nuclei. The results indicate that the conclusion of the experimental study that there is an excess of neutrons on the surface of heavy nuclei is substantially correct, though the

neutron-to-proton ratio may be lower (~3) than its initially estimated value (~5). (auth)

2085 ON THE MICROSCOPIC DESCRIPTION OF NUCLEI AT HIGH SPINS. Ethofer, S. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Kernphysik). Z. Phys.; 271: No. 2, 169-175(Dec 1974).

The behavior of nuclei at high angular momenta is studied within the framework of many-body Green functions. A theory is developed which can be applied to interacting Fermi-systems in strong external fields. In a qualitative calculation, using the semi-classical approximation, it is shown that at high angular momenta the ground state band can nearly coincide with the first vibrational band, which corresponds to a breakdown of the usual RPA approximation. The so-called "backbending" effect is also obtained. (auth)

2086 SYSTEMATICAL STUDY OF BETA DELAYED PROTON EMISSION ENERGIES. Bos, K.; Gove, N. B.; Wapstra, A. H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Z. Phys.; 271: No. 2, 115-127(Dec 1974).

Graphs are given of the maximum proton energies in delayed proton emitters. This quantity, equal to the difference of the electron capture decay energy of the precursor and the separation energy of a proton in the daughter, has been calculated in a least squares adjustment of mass spectroscopic data and nuclear decay and reaction energies. The graphs would lead to expect a 950 keV lower maximum proton energy in $^{73}Kr(\epsilon p)^{72}Se$ than has been reported from experiments. They can be used to predict new cases for further studies on this subject. (auth)

2087 COULOMB EXCITATION. McGowan, F. K.; Stelson, P. H. (Oak Ridge National Lab., TN). pp 3-54 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The theory of Coulomb excitation and a brief review of pertinent treatments of the Coulomb excitation process that are useful for the analysis of experiments are given. Examples demonstrating the scope of nuclear structure information obtainable from gamma spectroscopy are presented. Direct E lambda excitation of ^{232}Th is discussed in terms of the one phonon octupole vibrational spectrum. B(MI) reduced transition probabilities resulting from Coulomb excitation of odd-A deformed nuclei with heavy ions are presented as a test of the rotational model. The use of gamma ray coincidence and particle-gamma coincidence as tools for investigating Coulomb excitation is discussed. (SDF)

2088 COULOMB REORIENTATION. Haeusser, O. (Chalk River Nuclear Labs., Ont.). pp 55-91 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The change of observables in Coulomb excitation introduced by quadrupole moments of states (reorientation effect) is discussed, and a comparison is made of merits and limitations of existing methods for measurement of electric moments of excited states. Theoretical aspects essential for analysis of reorientation experiments and some experimental techniques with emphasis on recent developments are discussed. Data on 60 quadrupole moments of 2^+ states in even-even nuclei are presented and their relevance to nuclear structure is discussed. (SDF)

2089 MAGNETIC MOMENTS OF EXCITED STATES. Recknagel, E. (Freie Univ., Berlin). pp 93-141 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The discussion mainly emphasizes magnetic dipole moments of excited nuclear states. A short outline of hyperfine interactions and of the technique of perturbed angular correlations (PAC) is given. Experimental methods for measuring magnetic moments of excited states are introduced with an emphasis on nuclear reactions. Various theoretical models that have proved to be very successful in interpreting experimental results are discussed. (SDF)

2090 GAMMA RAYS FROM HEAVY-ION REACTIONS. Newton, J. O. (Australian National Univ., Canberra). pp 185-227 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

In heavy ion reactions, several neutrons can be evaporated before reaching particle stable states in the final nucleus, which then decay by gamma ray cascades to the ground state ((HI, xngamma) reaction). A qualitative outline of the theory of heavy ion reactions is given with emphasis on the (HI,xngamma) reaction. Experimental methods for observing these reactions are presented, and reactions with light target nuclei are discussed. Determination of structural information from heavy ion reactions is examined, and specific examples are given. (24 figures, 72 references) (SDF)

2091 ANGULAR CORRELATION METHODS. Ferguson, A. J. (Chalk River Nuclear Labs., Ont.). pp 277-306 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

An outline of the theory of angular correlations is presented, and the difference between the modern density matrix method and the traditional wave function method is stressed. Comments are offered on particular angular correlation theoretical techniques. A brief discussion is given of recent studies of gamma ray angular correlations of reaction products recoiling with high velocity into vacuum. Two methods for optimization to obtain the most accurate expansion coefficients of the correlation are discussed. (1 figure, 53 references) (SDF)

2092 LIFETIME MEASUREMENTS. Fossan, D. B. (State Univ. of New York, Stony Brook); Warburton, E. K. pp 307-374 of Nuclear Spectroscopy and Reactions. Part C. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Lifetime measurements are discussed, concentrating on the electronic technique, the recoil distance method (RDM), and the Doppler shift attenuation method (DSAM). A brief review of several indirect timing techniques is given, and their specific advantages and applicability are considered. The relationship between lifetimes of nuclear states and the nuclear structure information obtained from them is examined. A short discussion of channeling and microwave methods of lifetime measurement is presented. (23 figures, 171 references) (SDF)

2093 MANY FACETS OF NUCLEAR STRUCTURE. Bohr, A.; Mottelson, B. R. (Univ. of Copenhagen). Postepy Fiz.; 25: No. 6, 621-645(1974). (In Polish).

The many facets of nuclear structure are presented. The following problems associated with the treatment of the nuclear structure are considered: the nucleus as a quantal many-body problem, an interplay of the shell structure and nuclear deformations, heavy-ion reactions, the unified description of nuclear dynamics, the fine-grain structure of nuclear matter, the compound nucleus, direct interactions, isobaric analogue resonances, two-particle transfer reactions, rotational motions, and phase transitions induced by rotational perturbation. Connections between nuclear phenomena and different domains of quantal physics are pointed out. (auth)

2094 CALCULATION OF THE INDEPENDENT FISSION PRODUCT YIELDS AND FAST NEUTRON EMISSION BY FISSION FRAGMENTS. Koldobskii, A. B.; Kolobashkin, V. M.; Gusev, A. A. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 7-13(1974). (In Russian).

A method was described for the calculation of the independent fission product yields based on the consideration of the quantitative characteristics of fast neutron emission. The possibility of formulating and solving the inverse problem for fission by neutrons at ~14.5 MeV was examined. (tr-auth)

2095 CHANGES OF MEAN-SQUARE NUCLEAR CHARGE RADII FROM ISOTOPE SHIFTS OF ELECTRONIC K/sub alpha/ X-RAYS. Boehm, F.; Lee, P. L. (California Inst. of Tech., Pasadena). At. Data Nucl. Data Tables; 14: No. 5-6, 605-611 (1974).

Experimental results on K/sub alpha/ x-ray isotope shifts are summarized. The delta(r^2) values of the nuclear charge distribution, as derived from the data, are presented. A combination of x-ray and optical isotope shifts, in some cases, yields an improved accuracy for delta(r^2). The mass-shift corrections to the x-ray isotope shifts are presented. (auth)

2096 CHANGES IN MEAN-SQUARE NUCLEAR CHARGE RADII FROM OPTICAL ISOTOPE SHIFTS. Heilig, K.; Steudel, A. (Technische Univ., Hanover). At. Data Nucl. Data Tables; 14: No. 5-6, 613-638(1974).

Changes in mean-square nuclear charge radii, delta(r^2), are extracted from reported optical isotope and isomer shifts. Allowance for specific mass shifts is made and different methods for doing this are discussed. The change of the electronic charge density at the nucleus is evaluated by means of empirical data as much as possible. Whenever feasible, delta(r^2) is determined from isotope shifts measured in various electronic transitions as well as in different spectra of an element. Relative and absolute values of delta(r^2) are given in the Tables and are compared with delta(r^2) values obtained from electronic x-ray isotope shifts. There is fair agreement in most cases. (auth)

2097 CHANGES IN MEAN-SQUARE NUCLEAR CHARGE RADII FROM MOESSBAUER ISOMER SHIFTS. Kalvius, G. M. (Technische Univ., Garching, Ger.); Shenoy, G. K. At. Data Nucl. Data Tables; 14: No. 5-6, 639-653(1974).

From reported experimental values of Moessbauer isomer

shifts the change in nuclear mean-square charge radius, delta(r^2), upon excitation was extracted, using electron densities calculated through a Dirac-Fock-Slater routine. Application of a uniform scheme of evaluation should give better insight in systematic trends of delta(r^2). Also reported are generally more accurate ratios of delta(r^2) either for different resonances in one element or for resonances in chemically similar elements. The literature has been surveyed through June 1973. (auth)

2098 STABILIZATION OF THE CHARGED VACUUM CREATED BY VERY STRONG ELECTRICAL FIELDS IN NUCLEAR MATTER. Mueller, B. (Univ. of Washington, Seattle); Rafelski, J. Phys. Rev. Lett.; 34: No. 6, 349-352(10 Feb 1975).

The expectation value of electrical charge in charged vacuum is calculated utilizing the Thomas–Fermi model. Almost complete screening of the nuclear charge is found. For any given nuclear density there is an upper bound for the electrical potential. For normal nuclear densities this value is –250 MeV. This suggests that the vacuum is stable against spontaneous formation of heavy, charged particles. (auth)

2099 ON THE ROTATION OF NON-AXIAL NUCLEI. Brink, D. M.; Castro, J. J. (Oxford Univ. (UK). Dept. of Theoretical Physics). Z. Phys.; 271: No. 4, 345-348(Dec 1974).

The rotational properties of non-axial nuclei are studied by means of the generator coordinate method, and in particular it is shown that using the angular momentum projection technique and assuming the Gaussian overlap approximation for the Hamiltonian and overlap matrix elements, the Hill-Wheeler integral equation may be transformed into an equivalent Schroedinger equation for a non-axial rotator. (auth)

2100 NUCLEAR SPECTROSCOPY AND REACTIONS. Part B. Cerny, J. (ed.). Pure and Applied Physics, Volume 40-B. New York; Academic Press, Inc. (1974). 727p.

Charged particle spectroscopy and reactions are studied with both light and heavy ions, and spectroscopic investigations involving mesons and neutrons are described. Various topics are discussed in 16 individual papers. (SDF)

For abstracts of individual papers see: 1848, 1929, 1944, 1984, and 2101–2112.

2101 DIRECT REACTIONS INVOLVING LIGHT IONS: ELASTIC AND INELASTIC SCATTERING. Perey, F. G. (Oak Ridge National Lab., TN). pp 137-167 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).

Some of the more important theoretical aspects of the optical model and some features of optical model potentials are discussed. An analysis of elastic scattering data is presented, and some systematic studies that could be helpful in the analysis of nuclear reactions are reported. Inelastic scattering is discussed in the framework of a microscopic model, and some problems relating to its application are described. (2 figures, 1 table) (SDF)

2102 DIRECT REACTIONS INVOLVING LIGHT IONS: TRANSFER REACTIONS. Macfarlane, M. H. (Argonne National Lab., IL); Schiffer, J. P. pp 169-194 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).

Single nucleon transfer reactions are discussed with attention given to the (d,p) reaction. Other single nucleon transfer reactions involving projectiles with mass 4 or less are briefly discussed. General comments on the DWBA analysis of single nucleon transfer are given. A short examination of transfer reactions involving two, three, and four nucleons is made. (15 figures, 2 tables, 48 references) (SDF)

2103 DIRECT REACTIONS INVOLVING LIGHT IONS: POLARIZATION IN INELASTIC SCATTERING AND TRANSFER REACTIONS. Glashausser, C. (Rutgers-The State Univ., New Brunswick, NJ). pp 195-231 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (Ed.). New York; Academic Press, Inc. (1974).

Attention is focused on (d,p) and (p,d) reactions and on inelastic scattering of polarized protons with medium and heavy weight targets. Some less common reactions are briefly discussed. Measurements of polarization parameters in direct reactions and theoretical aspects are examined. Motivation for performing such measurements is given, and their utility is illustrated by examples drawn from the literature. (11 figures, 76 references) (SDF)

2104 HEAVY-ION-INDUCED REACTIONS: ELASTIC AND INELASTIC SCATTERING OF HEAVY IONS. Siemssen, R. H. (Argonne National Lab., IL). pp 233-278 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

A phenomenological approach to heavy ion scattering is given with an emphasis on deviations from strong absorption predictions. Parametrized phase shift models are compared and related to scattering data. Theoretical comments are made on heavy ion potentials. Elastic (resonant) transfer calculations are presented using DWBA, the Coulomb T Matrix, and the Two State Approximation. Intermediate structure in heavy ion reactions is discussed in terms of quasimolecular states. (15 figures, 124 references) (SDF)

2105 HEAVY-ION-INDUCED REACTIONS: SINGLE- AND MULTINUCLEON TRANSFER REACTIONS. von Oertzen, W. (Max Planck Inst. for Nuclear Physics, Heidelberg). pp 279-342 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

A general survey of the dynamical properties of heavy ion induced reactions and a brief summary of different experimental methods are presented. The distorted wave Born approximation for single nucleon transfer is detailed. Specific features of heavy ion reactions including recoil effects and internal structure are considered, and examples of multinucleon transfer reactions illustrating these properties are given. Reactions involving the transfer of several nucleons are discussed within the framework of nuclear spectroscopy. (28 figures, 1 table, 147 references) (SDF)

2106 SPECIALIZED REACTIONS: LEVEL DENSITIES AND FLUCTUATION PHENOMENA. Richter, A. (Ruhr Univ., Bochum, Ger.). pp 343-391 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Various aspects of nuclear level densities and nuclear cross section fluctuations are discussed. Properties and behavior of states in which a nucleus can exist are examined. The fluctuations discussion emphasizes the magnitude of the fluctuating cross section, the coherence width, and the separation between direct and compound nucleus contributions to the cross section. Models are described and the quoted theoretical results are applied to the interpretation of experimental data. Specific examples of data are presented. (19 figures, 3 tables, 95 references) (SDF)

2107 SPECIALIZED REACTIONS: REACTIONS AT INTERMEDIATE ENERGIES: BARYON–NUCLEUS COLLISIONS, 150 MeV–1 GeV. Igo, G. (Univ. of California, Los Angeles). pp 393-454 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The high energy collision approximation proposed by Glauber to describe experimental data at the upper end of the intermediate range is reviewed. Some aspects of the model which limit its validity are outlined. Elastic scattering of protons from light nuclei is discussed in the framework of the Glauber model. For data in the energy region near 200 MeV, the plane wave impulse approximation (PWIA) and the distorted wave impulse approximation (DWIA) are applied. Quasielastic scattering is treated by considering (p,p') and (p,2p) reactions with light nuclei. A short discussion of the high resolution spectrometer facility at LAMPF and the SPES 1 facility at Saturne is given. (46 figures, 3 tables, 102 references) (SDF)

2108 RADIATIVE CAPTURE AND CHARGE EXCHANGE REACTIONS. Crowe, K. M. (Univ. of California, Berkeley); Truoel, P. pp 493-526 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Radiative pi capture at rest in nuclei A less than 4 is studied and various experimental parameters are summarized. Radiative capture in ^{4}He and in nuclei with Z greater than 2. A greater than 4 is described in detail and the possibility of the existence of resonance structures is discussed. An analysis of single and double charge exchange reactions is presented, and a summary of charge exchange data is included. (15 figures, 5 tables, 146 references) (SDF)

2109 SCATTERING AND DIRECT REACTIONS. Tanner, N. W. (Nuclear Physics Lab., Oxford). pp 527-569 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The character and description of pion-nucleon scattering and pion absorption are summarized. High energy scattering is treated by the Glauber approximation and scattering near the 3-3 (J equals $\frac{3}{2}$, I equals $\frac{3}{2}$) resonance is discussed. Pion-nucleus inelastic scattering is examined in terms of the single scattering approximation. A discussion of single and two nucleon absorption is given with reference to available data. Special topics, including strangeness exchange and hypernuclei and short range correlations, are given brief consideration. (22 figures, 57 references) (SDF)

2110 ADVANCES IN MEASUREMENTS OF NEUTRON SPECTRA. Finckh, E. (Hahn-Meitner Inst. for Nuclear Research, Berlin). pp 573-612 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Different methods of neutron energy measurements in the range from about 100 keV to 30 MeV are discussed. Methods based on the frequently used neutron-hydrogen scattering are reviewed, and neutron induced reactions on ^{3}He and ^{6}Li are described. Neutron polarization employing the analyzing power of the neutron-^{4}He scattering is investigated. A brief discussion of other types of neutron detectors is given. (15 figures, 1 table, 159 references) (SDF)

2111 CHARGE EXCHANGE REACTIONS. Anderson, J. D. (Univ. of California, Livermore). pp 613-634 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

A review of the characteristics of charge exchange reactions for light (A equals 3-39), medium weight (A equals 40-100) and heavy nuclei (A greater than 100) is presented. Topics discussed include analog transitions, angular distributions and the Coulomb displacement energy. Experimental results for various properties are compared with calculated values. (12 figures, 1 table, 71 references) (SDF)

2112 POLARIZATION PHENOMENA IN NUCLEAR REACTIONS OBSERVED IN NEUTRON STUDIES. Walter, R. L. (Duke Univ., Durham, NC). pp 635-671 of Nuclear Spectroscopy and Reactions. Part B. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

An overview of what has been attempted in the polarization field with neutrons and an interpretation of the significance are presented. The coverage includes a wide variety of topics but is limited to energies between 100 keV and 30 MeV. An attempt is made to produce a brief but complete view of polarization phenomena as it relates to nuclear models and fundamental interactions. (14 figures, 112 references) (SDF)

2113 SHELL EFFECTS IN THE NUCLEAR DEFORMATION ENERGY. Ross, C. K. Hamilton, Ont.; McMaster Univ. (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

Although the Strutinsky method has been widely used in calculating the nuclear deformation energy, it contains various ambiguities which may affect the accuracy and reliability of the calculations. In particular, the smoothing procedure for extracting the smooth density of states used in calculating the shell correction to the deformation energy has no firm theoretical basis. As a means of testing this smoothing procedure, an alternative method for obtaining that part of the exact density of states which depends only on the overall features of the distribution of single-particle states is proposed. This approach utilizes a high temperature expansion of the exact single-particle partition function, and it is used to calculate the shell correction for three different spectra for which the partition function is known analytically at high temperatures. The shell corrections calculated by the partition function method are compared with the corresponding results from the Strutinsky method, and they are found to be in reasonable agreement. (LBS)

2114 CORIOLIS EFFECTS AND ROTATION ALIGNMENT IN NUCLEI. Stephens, F.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Rev. Mod. Phys. 47: No. 1, 43-65 (Jan 1975).

Some of the principal Coriolis effects in nuclei are described, beginning with situations where they consists of small perturbations in the level spectrum and concluding with cases where they produce some of the dominant features of the low-energy spectrum. In the latter case a new coupling scheme becomes relevant, where the angular momentum of an individual particle has a constant projection along the direction of the total angular momentum of the system. This scheme appears to be applicable for some odd-mass nuclei in the so-called "vibrations" regions, and also for very high spin ($\sim$20 h) yrast states in some even-even nuclei. (AIP)

2115 DENSITY-MATRIX EXPANSION FOR AN EFFECTIVE NUCLEAR HAMILTONIAN. II. Negele, J.W. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Vautherin, D. Phys. Rev. C 11: No. 3, 1031-1041 (Mar 1975).

The density matrix expansion (DME) was originally introduced to establish contact between microscopic many-body theory based on a realistic two-body interaction and simplified phenomenological interactions of the Skyrme type. As a result of subsequent applications of the DME and simple phenomenological forces to deformed nuclei and problems in nuclear collective motion, several extensions to the original work are presented. The surface energy coefficient is shown to be -19.06 MeV when the spin-orbit and starting energy contributions are included, yielding excellent agreement with the semiempirical mass formula value of -18.56. The dominant effects of finite range are shown to be straightforwardly included in the direct Hartree term, and the Pauli operator is expressed in terms of the density matrix, yielding new insight into the local density approximation. Detailed comparisons are presented with Skyrme forces, and the density of states at the Fermi surface is shown to be reasonably well reproduced with the DME. (auth)

2116 CONSEQUENCES OF NUCLEAR DYNAMICS FOR THE NONRELATIVISTIC πNN VERTEX. Eisenberg, J.M.; Noble, J.V.; Weber, H.J. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. C 11: No. 3, 1048-1050 (Mar 1975).

We examine the form of the πNN vertex in the nonrelativistic limit, under various assumptions on the dynamics of the emitting or absorbing nucleon. (auth)

2117 EIKONAL CALCULATIONS FOR HIGH-ENERGY ELECTRON-NUCLEUS SCATTERING. Murphy, J.D. (Department of Physics, Catholic University of America, Washington, D.C. 20064); Überall, H. Phys. Rev. C 11: No. 3, 829-844 (Mar 1975).

The complete electron-nucleus cross section, containing both longitudinal and transverse interactions, has been obtained for elastic as well as inelastic scattering using the eikonal wave functions of Yennie *et al.* This approach is based on the distorted-wave Born approximation, and retains only the leading term in an asymptotic expansion (in inverse powers of momentum transfer times nuclear radius) of the eikonal integrals. The method should be valid at electron energies above 2–300 MeV, and should constitute an improvement over the phase-shift method when the latter becomes inaccurate above 4–500 MeV. A simple collective nuclear model for magnetic transitions is also given, which contains the rotational collective flow of nuclear charge. (auth)

2118 ANALYSIS OF ONE-NUCLEON TRANSFER REACTIONS BETWEEN HEAVY IONS IN TERMS OF EXACT FINITE-RANGE DISTORTED-WAVE BORN-APPROXIMATION CALCULATIONS. Low, K.S.; Tamura, T. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712). Phys. Rev. C 11: No. 3, 789-804 (Mar 1975).

A new technique is developed to carry out exact finite-range distorted-wave Born-approximation calculations very quickly, and is applied to analyze a large amount of data for one-nucleon transfer reactions between heavy ions. It is confirmed that heavy-ion induced reaction data, if analyzed in terms of an exact finite-range approach, can be used as a dependable spectroscopic tool. (auth)

2119 ROLE OF ORTHOGONALITY SCATTERING IN COLLISIONS OF COMPOSITE PARTICLES. Shakin, C.M.; Weiss, M.S. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 11: No. 3, 756-759 (Mar 1975).

In the scattering of composite particles there exist states of relative motion of the composites which are not allowed when one imposes the requirements of the Pauli principle. In this work we show how such redundant states may be identified and how the scattering solutions may be made orthogonal to these states. The strong repulsive forces existing between the composites may be understood in this context. We discuss the role of the redundant solutions in the resonating group method, using the calculation of ($3N$-$3N$) scattering as an example, and also comment on the nucleon-nucleon scattering problem. (auth)

2120 ANALYSIS OF THREE-BODY FINAL STATES: NONRELATIVISTIC. Amado, R.D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 11: No. 3, 719-733 (Mar 1975).

Quantum mechanics forces rapid variation and coherent interrelation on amplitudes usually taken to be independent and constant in the Watson approximation to final-state interactions. These effects are particularly important when more than one pair of final-state interactions is simultaneously big. We develop these amplitude conditions using unitarity only. We show how these constraints combined with analyticity give a set of linear scattering integral equations. These equations are not only the minimal set compatible with the general constraints of quantum mechanics, but also turn out to be the simplest form of the separable interaction equations. (auth)

2121 CLASSICAL DESCRIPTION OF THE COULOMB EXCITATION OF VERY HEAVY DEFORMED NUCLEI. Rowley, N.; Colombani, P. (Institut de Physique Nucléaire, 91406 Orsay, France). Phys. Rev. C 11: No. 3, 648-653 (Mar 1975).

Classical perturbation theory is used to obtain an idea of the "suddenness" of the Coulomb excitation of rotational levels of very heavy nuclei. Deviations from Rutherford orbits in such reactions are also estimated and found to be small. Classical values of the maximum J obtainable in a given reaction are found to be in good agreement with values obtained experimentally using heavy deformed targets (^{238}U, ^{232}Th) and heavy beams (^{132}Xe, ^{84}Kr). (auth)

2122 COMMENT ON NUCLEAR SHOCK WAVES IN HEAVY-ION COLLISIONS. Bertsch, G.F. (Department of Physics and

Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. Lett. 34: No. 11, 697-698 (17 Mar 1975).

Heavy-ion collisions are not likely to produce shock waves and baryon densities greater than twice the nuclear matter density, contrary to the conclusions of Scheid, Müller, and Greiner. (auth)

2123 INDUCED COULOMB CORRECTIONS TO THE $0^- \leftrightarrow 0^+$ β DECAY. Bottino, A.; Ciocchetti, G. (Istituto di Fisica dell'Universitá, Torino, Italy and Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Italy); Kim, C.W. Phys. Rev. C 11: No. 3, 991-997 (Mar 1975).

We calculate the *induced* Coulomb correction as well as the usual Coulomb correction, to order αZRW_0, to the first-forbidden $0^- \leftrightarrow 0^+$ β decay and demonstrate that the induced correction, through the pseudoscalar form factor term, is dominant among all the Coulomb corrections. (auth)

2124 EQUIVALENCE OF THE MARUHN-GREINER THEORY AND THE STATISTICAL THEORY OF FISSION. Fong, P. (Physics Department, Emory University, Atlanta, Georgia 30322). Phys. Rev. Lett. 34: No. 11, 699-700 (17 Mar 1975).

It is shown that the Maruhn-Greiner theory of fission mass distribution and the statistical theory of fission are equivalent mathematically and physically. With the potential energy calculations employed similar to each other, the results of the two theories on mass distribution and its energy dependence are therefore very close to each other. (auth)

2125 ELECTROSTATICAL ENERGY OF A CHARGED SOLID DEFINED BY TWO SPHERICAL CAPS. Gaudin, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France), Service de Physique Theorique). J. Phys. (Paris); 35: No. 12, 885-894(Dec 1974). (In French).

The Coulomb energy of a uniformly charged solid whose boundaries are defined by two spherical caps is given in term of elementary functions. The result is applied to the potential energy of two spherical nuclear drops penetrating each other. (FR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 739, 1024, 1117, and 1134.

2126 (AED-CONF-74-509-028) COMPARISON OF MEASURED AND COMPUTED VALUES FOR THE IONIZATION IN VARIOUS GASES IRRADIATED WITH 15 MeV NEUTRONS. Delafield, H. J.; Chuang, L. S.; Holt, P. D. 1974. 15p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

Ionization measurements are reported for 15 MeV neutrons obtained with a parallel plate ionization chamber employing different wall materials. The chamber consisted of a graphite back electrode and interchangeable front electrode. It was irradiated with neutrons incident normally upon the front plate. Since recoils from the chamber wall are produced in a forward direction, the influence of the graphite back plate was very small. Hence by changing the front electrode and filling gas, measurements were made for chambers of different atomic composition. Measured values of the ionization in different gases relative to that in acetylene show agreement to better than 5% with the calculations of Dennis, providing confidence both in the relative values of cross sections and the W values used as input data in the calculations. Relative values of kerma derived from the experimental measurements were also in good agreement with the earlier calculations of Bach and Caswell. Values of neutron flux density derived from the ionization measurements were within about 10% of the value measured independently with a calibrated ^{238}U fission chamber. This satisfactory agreement between ionization and flux density measurements increases confidence in the methods employed for neutron dosimetry. (auth)

2127 ELECTRON TRANSPORT IN THE PRESENCE OF UNIFORM MAGNETIC FIELDS. Halbleib, J. A. Sr. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 221-226(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The model presented describes the transport of relativistic electrons through extended media in the presence of static external magnetic fields of arbitrary spatial orientation. The material geometry must be one-dimensional; however, since the model employs a full three-dimensional description of electron and photon trajectories, one can easily obtain selected two- or three-dimensional outputs from symmetry-breaking source distributions and field orientations. Model versatility is demonstrated through its application to three diverse areas of pulsed-electron-beam research. (auth)

2128 VELOCITY DEPENDENT ENERGY LOSSES OF ^{7}Li-IONS. BAEURLE, T. Cologne; Univ. Cologne (1972). 33p. (In German).

Thesis.

The velocity dependence of the electronic stopping cross section of ^{7}Li ions in various boron compounds is investigated in the energy region of 100 keV to 840 keV. The measurements show that the electronic stopping cross section is proportional to the velocity of the ^{7}Li ions in this energy region. This result is compared with theoretical calculations and other experiments. The comparison shows that the theory correctly describes the velocity dependence of the electronic stopping cross section over the whole region, but that for smaller regions, deviations from the proportionality can arise due to the shell effect and the charge state of the ^{7}Li ions. The molecular stopping cross section is calculated for the measured boron compound starting from the proportionality. (GE)

2129 APPLICATION OF HEAVY CHARGED HIGH-ENERGY PARTICLES FOR MEDICINE. Goldin, L. L.; Dzelepow, W. P.; Lomanow, M. F.; Sawczenko, O. W.; Choroszkow, W. S. (Inst. of Theoretical and Experimental Physics, Moscow). Postepy Fiz.; 25: No. 6, 647-675(1974). (In Polish).

Methods, advantages, results and perspectives of the application of heavy charged high-energy particles for radiotherapy and radioneurosurgery are discussed. (auth)

2130 AN EXPERIMENTAL INVESTIGATION OF THE EXPONENTIAL ATTENUATION OF BETA RADIATION FOR DUST MEASUREMENT. Sem, G. J.; Borgos, J. A. (Thermo Systems, Inc., Saint Paul, Minn. (USA)). Staub-Reinhalt. Luft; 35: No. 1, 5-9(Jan 1975).

The attenuation of beta radiation as it passes through a collected deposit of dust particles is now used to measure the mass concentration of airborne dust. Previous investigators assumed that a single exponential function describes the attenuation I/I_0 of beta radiation passing through the deposit. This study investigated experimentally the nonexponential character of beta radiation attenuation for a specific source-substrate-detector geometry. For two beta sources, C^{14} and Pm^{147}, the data and a quasi-theoretical analysis indicates that I/I_0 is not a simple exponential function of particulate thickness density (mg/cm^2) and as a result, a different calibration curve exists for every initial radiation intensity I_0. For the sensor geometry tested, these effects cause measurement errors well in excess of 10% if the commonly accepted exponential calibration is assumed. It is recognized that variations in the sensor geometry may strongly influence the relationship of attenuation to particulate density. (auth)

2131 HEAT DEFECT OF LOW ENERGY X-RAYS IN SOME MATERIALS OF INTEREST IN ABSORBED DOSE CALORIMETRY. Saebel, M.; Schmidt, T.; Pauly, H. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Inst. fuer Physikalische und Medizinische Strahlenkunde). Radiat. Environ. Biophys.; 11: No. 3, 259-264(Oct 1974).

The amount of energy absorbed in material and not converted to heat is identical with the (negative or positive) heat of reactions and other processes induced by radiation. This fraction of energy is called "heat defect." In order to determine the defect, which is generally a very small effect, a precise isothermal twin calorimeter was constructed. One of the absorbers consisted of the material to be investigated. We obtained (for 30 kV X-rays, LET between 1 and 30 keV/μm tissue-equivalent material) the following values for the heat defect (in %, standard deviations): Carbon (reactor graphite) 0.38 ± 0.61; Polystyrene 0.67 ± 0.94; Polyethylene 3.80 ± 0.96; Polymethylmethacrylate 2.31 ± 0.78; Polyamide 6.95 ± 0.94; Polyvinylchloride 2.01 ± 0.68; Shonka-plastic 4.08 ± 0.55. The value of the heat defect in polymethylmethacrylate depends on the dose. The value is negative (–25%) for the non-irradiated substance in equilibrium with air, becomes positive at about 100 krd and reaches a final value of 2.31% after a dose of about 200 krd. Knowing the radiochemical reactions, the corresponding G-values and the energy of chemical bonds changed, it is possible to calculate the value of the heat defect, which was found to be rather close to the value measured in some plastics. (auth)

Radiation Protection Standards

Refer also to abstracts 891, 1116, and 1136.

2132 (PB-237744) EVALUATION OF METHODS FOR SETTING OCCUPATIONAL HEALTH STANDARDS FOR URANIUM MINERS. Final Report, June 1972–March 1974. Cross, F. T.; Bloomster, C. H.; Hendrickson, P. L.; Nelson, I. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1974. 315p. (NIOSH-72-2). NTIS $9.25.

A retrospective look is presented on the methods employed by the National Institute for Occupational Safety and Health (NIOSH) over the past 30 years in the development of radiation exposure standards for uranium miners. The cost-effectiveness of the standards setting methodologies are also compared based on a theoretical model of miner employment. (GRA)

Shielding Calculations and Experiments

2133 POINT ISOTROPIC GAMMA-RAY BUILDUP FACTORS IN CONCRETE. Eisenhauer, C. M. (National Bureau of Standards, Washington, D. C.); Simmons, G. L. Nucl. Sci. Eng.; 56: No. 3, 263-270(Mar 1975).

Gamma-ray buildup factors in ordinary concrete have been calculated by the moments method. Results for concrete kerma and air kerma are tabulated for source energies from 15 MeV to 15 keV. Parameters are given that allow calculation of the buildup factor by means of a simple analytic expression. Comparisons are made with earlier calculations, and the effects of annihilation radiation are discussed. (auth)

PHYSICS (THEORETICAL)

Refer also to abstract 1834.

General

2134 BOLTZMANN COLLISION OPERATOR WITH INVERSE-POWER INTERMOLECULAR POTENTIALS. I. Pao, Y. P. (New York Univ., NY). Commun. Pure Appl. Math.; 27: 407-428 (1974).

The linearized Boltzmann equation in the kinetic theory of gases with repulsive intermolecular potentials is considered. The special case of Maxwell molecular model or Maxwell gas is considered. (JFP)

2135 BOLTZMANN COLLISION OPERATOR WITH INVERSE-POWER INTERMOLECULAR POTENTIALS. II. Pao, Y.P. (New York Univ., NY). Commun. Pure Appl. Math.; 27: 559-581 (1974).

The eigenvalue problem of the collision operator in the linearized Boltzmann equation with a repulsive inverse-power intermolecular potential is discussed. It is proven that the collision operator has a purely discrete spectrum and its eigenfunctions exist and form a complete orthonormal set. The special case of the Maxwell gas is considered. (JFP)

2136 SYMBOLIC COMPUTING AND ITS RELATION TO PARTICLE PHYSICS. Campbell, J. A. (King's Coll., Cambridge, Eng.). Acta Phys. Austr., Suppl.; No. 13, 595-647(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

Symbolic computing is defined and various approaches to symbolic computation are outlined. Some distinctive properties of symbolic computation are then discussed. A survey is given of symbolic computing in particle physics and of some applications in celestial mechanics, physical chemistry, and general relativity. (LBS)

2137 METHODS OF ARTIFICIAL INTELLIGENCE AND COMPUTATIONS IN PHYSICAL SCIENCES. Cambell, J. A. (King's Coll., Cambridge, Eng.). Acta Phys. Austr., Suppl.; No. 13, 649-663(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The concept of artificial intelligence is viewed as any physical program which changes itself or its given constants. Several classes of programs are discussed. The implications of artificial intelligence for physical problems are then discussed. (LBS)

2138 N-BODY PROBLEM. Sandhas, W. (Univ., Bonn). Acta Phys. Austr., Suppl.; No. 13, 679-709(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

N-body integral equations are derived which represent a natural realization of typical aspects of the multichannel collision theory. It is concluded that a systematical N-body generalization of two-body equations should be accomplished by introducing systems of relations which preserve their algebraic structure. In particular, the correct N-body analogue of the single channel Lippmann-Schwinger equation is discussed. A comparison is made with the Faddeev-Yakubovsky equations. (LBS)

2139 SIGNIFICANCE OF CONSERVATION OF ENERGY. Schlueter, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 107-122 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German)

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

The concept of energy is defined. The practical, experimental, and theoretical aspects of the conservation of energy are discussed, and the growth of the concept of conservation of energy is outlined. (JSR)

2140 SOME NEW APPROACHES TO THE STUDY OF THE PROPERTIES OF THE GENERALIZED WKB APPROXIMATION. II. Zhirnov, N. I.; Sokolov, A. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 65-71(1974). (In Russian).

The study begun in part I of the possibility of applying the Froeman formalism to the study of the properties of the generalized WKB approximation was continued. Model evaluations, limiting properties, and the symmetry ratios of the F matrix were obtained and studied. The representation of the approximate solution of the Schroedinger equation in the form of absolutely and equally converging series was discussed. (tr-auth)

2141 FOUNDATIONS OF LASER THEORY. Ingarden, R. S. (Univ., Turin). Postepy Fiz.; 25: No. 6, 687-701(1974). (In Polish).

Three main schools of thought in laser theory (Scully-Lamb, Haken-Lax and Ingarden-Kossakowski) are shortly reviewed and compared with the recent axiomatic approach by Hepp and Lieb to the Haken-Lax theory. Three levels of abstraction are distinguished: that of quantum field-theory of the complete system (including the surroundings)—the microscopic level, that of stochastic non-hamiltonian quantum mechanics—the semi-macroscopic level, and that of information thermodynamics—the macroscopic level. The last two levels give theories of a laser as an open system, a dynamical and a thermodynamical one. (auth)

2142 STOCHASTIC ELECTRODYNAMICS AND QUANTUM MECHANICS INTERPRETATION. Surdin, M. (Bordeaux-1 Univ., 33 - Talence (France)). Compt. Rend., Ser. A, B; 278: No. 20, 881-883(13 May 1974). (In French).

Many quantum mechanics results, including the Schroedinger equation and the conjugate equation, may be established in wave space by stochastic electrodynamics (SED) using strictly classical arguments. These equations are obtained by carrying out a Fourier transformation of the Fokker-Planck diffusion probability equation relative to the motion of the particle considered. It is concluded that the interpretation of quantum mechanics in the context of SED is that proposed by Einstein. (FR)

Quantum Field Theories

Refer also to abstracts 1773, 1788, and 1790.

2143 (JINR-P2-8210) SUPERGAUGE TRANSFORMATIONS OF FIELDS. Nguyen Van Hieu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The supergauge transformations of fields are studied. One considers in detail the transformation laws for the components of a scalar superfield and obtains five supergauge multiplets. One of them can also be obtained by studying a spinor superfield. Among five supergauge multiplets only one can satisfy the reality condition. (auth)

2144 (JINR-P2-8242) CONFORMAL PROPERTIES OF BILOCAL FIELDS. Zaikov, R. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The law of conformal transformations of bilocal fields is considered. The representation of the two-point function of the bilocal field as an expansion on the two-point functions of the basic tensor fields is derived. (auth)

2145 (JINR-P2-8370) CONFORMAL MOMENTUM OF THE ELECTROMAGNETIC FIELD. Pestov, A. B.; Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The conformal momentum of the electromagnetic field is studied. The scalar product in the space of the solutions for the Maxwell equations is determined. The theorem about the integral of the electromagnetic energy-momentum tensor is proved. The rules of quantization of the electromagnetic field in any Riemann world are formulated. Conformal invariance of the photon behavior is proved. (auth)

2146 (PP-424) ABOUT SEARCH FOR MAGNETIC MONOPOLES. Recami, E.; Mignani, R. (Catania Univ. (Italy). Istituto di Fisica Teorica). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The mere special relativity does not predict existence of (subluminal) monopoles, but on the contrary predicts existence of superluminal (tachyon) monopoles, with magnetic charge about 100 times less than usually assumed. This fact is quite relevant for the current experiments looking for magnetic poles. (auth)

2147 MASS SHELL AND NONLOCALITY IN ELECTRODYNAMICS. Rohrlich, F. (Syracuse Univ., NY). Acta Phys. Austr., Suppl.; No. 13, 487-533(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

A formulation of classical electrodynamics in which the interaction is partly via fields (radiation fields) and partly via action-at-a-distance is first reviewed and its reasons for success as

compared to the conventional theory are discussed. A quantum electrodynamics formulation is then constructed in analogy. The only electromagnetic field in the new form of QED is the free field. It is then shown that, as a consequence, there is no longer a gauge problem and that one is led to a theory with a positive definite Hilbert space. (LBS)

2148 EIKONAL APPROXIMATION IN QUANTUM FIELD THEORY. Dietz, K. (Univ., Bonn). Acta Phys. Austr., Suppl.; No. 13, 711-736(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

Theoretical aspects of the eikonal approximation are discussed. In the first section the eikonal approximation for the Green's function and the scattering matrix of a particle moving in an external field are reviewed. The relative high-energy behavior of higher approximants is calculated. It is illustrated that the eikonal asymptotics depend on the dimension of the coupling constant. In the second section a method is outlined for the eikonalization of the one-loop two-point Green's function for the motion of a particle in an external field. (LBS)

2149 REVIEW OF RECENT WORK ON FINITE QUANTUM ELECTRODYNAMICS. Fry, M. P. (Univ., Graz). Acta Phys. Austr., Suppl.; No. 13, 737-766(1974).

From 13th international university week for nuclear physics on progress in particle physics; Steiermark, Austria (4 Feb 1974). See CONF-740245-.

The work of Johnson, Baker, and Willey (JBW) and Adler is reviewed in some detail. The basic assumptions of JBW in their study of the short-distance behavior of quantum electrodynamics are reviewed, starting from the Schwinger-Dyson equation for the unrenormalized electron propagator S. Other topics deal with quantum electrodynamics and critical phenomena, the behavior of S(p) for large p^2 and the value of the bare electron mass; Goldstone bosons in quantum electrodynamics; the behavior of the unrenormalized photon propagator $\tilde{D}(q)$ for large q^2, and the calculation of the eigenvalue function. (LBS)

2150 THE ABSENCE OF EVEN BOUND STATES FOR $\lambda(\pi^4)_2$. Spencer, T. (Institut des Hautes Etudes Scientifiques, 91 - Bures-sur-Yvette (France)). Commun. Math. Phys.; 77-79: (Nov 1974).

Correlation inequalities for $\lambda(\pi^4)_2$ are used to exclude even bound states of energy less than 2m. (auth)

2151 ADIABATIC THEOREM IN AXIOMATIC QUANTUM FIELD THEORY. Schwarz, A. S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). Commun. Math. Phys.; 39: No. 1, 33-48(Nov 1974).

It is shown that Moeller matrices $S^{\pm}$ and scattering matrix S in axiomatic field theory can be expressed through their adiabatic analogs. Corresponding results in Hamiltonian approach are discussed. (GE)

2152 FUNCTIONAL METHODS AND PERTURBATION THEORY. Iliopoulos, J. (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France); Itzykson, C.; Martin, A. Rev. Mod. Phys. 47: No. 1, 165-192 (Jan 1975).

The framework of functional integrals in field theory is convenient for presenting a unified view of the perturbation expansion according to the number of loops. We review the calculation of the generating functional for irreducible Green functions and its renormalization properties. Calculations of the effective potential and Z-function are carried up to the order of two loops for the self-coupled scalar field. This is applied to compute the coefficients of the Callan-Symanzik equation which describes the short distance behavior of the theory. In conclusion, we present some speculations concerning the positivity of the coupling constant, and its relation to the on-shell two-particle scattering amplitude. (auth)

2153 A NEW POSSIBLE COMPOSITE QUANTIZED FIELD THEORY. Zuo-xiu, H.; Tao, H. (Institute of Atomic Energy, Academia Sinica). Chin. J. Phys. (Peking) (Engl. Transl.); 23: No. 2, 70-91(Sept 1974).

A new composite quantized field theory is formulated. A bilocal field operator equation of the Bethe-Salpeter type with sources is introduced as the equation of motion of composite fields. The bound state field theory of Haag-Nishijima-Zimmermann and Mandelstam's transition equation for the bound state can be shown to be contained in the present theory. Some difficulties of their theory are being avoided. (auth)

2154 TWO APPROACHED CONSERVATION LAWS FOR THE RADIATIVE YANG-MILLS FIELD. Kerner, R. (Paris-6 Univ., 75 (France)). Compt. Rend., Ser. A, B; 278: No. 19, 1275-1278(6 May 1974). (In French).

A simplified variation of the stationary phase method is applied to the Yang and Mills field equations. Assuming that the behavior of the approximate high-frequency radiative field is determined (up to the order of magnitude of the inverse of the frequency) by the phase function and its first derivatives, the Lagrange equations relative to these dynamic variables are deduced. These equations take the form of conservation laws. (FR)

Gravitation and General Relativity

Refer also to abstract 1711.

2155 CONSTANT TENSOR FIELDS IN THE GENERAL THEORY OF RELATIVITY. III. Kremen'kov, O. V.; Polozov, M. N. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 81-85(1974). (In Russian).

A simple criterion is obtained of covariant constancy in a timelike direction of an arbitrary tensor field. On application to a gravitational field it is shown: the curvature tensor of a Kerr field, in contrast to a Schwarzschild field is not covariantly constant; the plane waves of Peres and Takeno are covariantly constant, and the plane waves of Bondy-Pirani-Robinson are variable. (tr-SJR)

2156 TWO TYPES OF DIRAC FIELDS IN THE GENERAL THEORY OF RELATIVITY. Shishkin, G. V. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 86-90(1974). (In Russian).

An investigation is made of the possibilities of realizing the hypothetical interaction of Markov responsible for the difference in masses of the muon and electron. It is shown that within the framework of the general theory of relativity the interaction of Markov is not realized at a known value of spinor coupling. 8 refs. (tr-SJR)

2157 FRAMEWORKS FOR ANALYZING AND TESTING THEORIES OF GRAVITY. Lee, D. L. Pasadena, CA; California Inst. of Tech. (1974). 162p. University Microfilms Order No. 74-24,447.

Thesis (Ph. D.).

Theoretical frameworks are presented for the analysis and testing of gravitation theories--both metric and nonmetric. For nonmetric theories, the high precision Eotvos-Dicke-Braginskii (EBD) experiments are demonstrated to be powerful tests of their gravitational coupling to electromagnetic interactions. All known nonmetric theories are ruled out to within the precision of the EDB experiments. A new metric theory of gravity is presented that cannot be distinguished from general relativity in all current and planned solar system experiments. However, this theory has very different gravitational-wave properties. Hence, the need for further tests of metric theories beyond the Parametrized Post-Newtonian formalism is pointed out and the importance of the observation of gravitational waves as a tool for testing relativistic gravity in the future is emphasized. A theory-independent formalism delineating the properties of weak, plane gravitational waves in metric theories is set up. General conservation laws that follow from variational principles in metric theories of gravity are investigated. (Diss. Abstr. Int., B)

2158 NUMERICAL CALCULATION OF BOUND GEODESICS IN THE KERR METRIC. Goldstein, H. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 271: No. 3, 275-279(Dec 1974).

Time-like goedesics, especially bound orbits in the equatorial plane ($\theta = \pi/2$) and spherical orbits (r = const), are calculated numerically. The orbits are plotted using the Kerr-Schild coordinate system. The periastron advance and the dragging of nodes have the same values in any coordinate system and can be directly measured by an observer at infinity. (auth)

2159 LIMITS OF APPLICABILITY OF GUPTA'S THEORY. Poznanin, P. L. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 110-114(1974). (In Russian).

The applicability of the quantum theory of weak gravitational fields (Gupta's theory) was examined on the basis of a quasi-classical general relativistic point of view. It was shown that in the standard quantum theory particle energies can not be arbitrary but are limited both from above and below. These limitations arise as a result of the impossibility of assuming the region of interaction of elementary particles as part of two-dimensional space. The lower limit depends on the curvature tensor of the external gravitational field and the upper limit is determined by the gravitational field of the particles themselves. (tr-auth)

2160 COMPLEXIFICATION OF THE EINSTEIN EQUATIONS. Papyrin, A. F. (Dnepropetrovsk Construction-Engineering Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 149(1974). (In Russian).

It was shown that expansion of the manifolds on which the Einstein equations are developed up to the Cayley manifolds makes

it possible to comprehend the role of unified symmetry, introduced phenomenologically, in elementary particle physics. (JSR)

2161 THE SCALAR–TENSOR GRAVITATIONAL WAVES.
Qi–keng, L.; Yu–fen, L.; Zhen–long, Z.; Han–ying, G. (Academia Sinica). Chin. J. Phys. (Peking) (Engl. Transl.); 23: No. 2, 60-69 (Sept 1974).

We give here a complete proof for the results of our previous paper and show that the type–D scalar–tensor waves do not exist. (auth)

REACTOR TECHNOLOGY AND REGULATION

Refer also to abstract 1834.

2162 (AED-CONF-74-537-001) NUCLEAR POWER PLANTS. Sparhuber, R. (Kraftwerk Union A.G., Erlangen (F.R. Germany)). 1974. 36p. (In German). INIS.

From seminar: technology of modern thermal power plants; Essen, F.R. Germany (13 Nov 1974).

A general summarizing review on reactor physics and technology as well as on the particularities of the various reactor lines is given. The main attention is focussed on the reactor types represented in the FRG. (GE)

2163 (AED-CONF-74-538-022) CO-OPERATION OF ECONOMY, SCIENCE AND STATE—ILLUSTRATED BY THE EXAMPLE OF THE 4TH ATOMIC PROGRAMME AND THE RAHMENPROGRAMME ENERGY RESEARCH. Lehr, G. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany)). 1974. 14p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F.R. Germany (23 Oct 1974).

2 figs.; 1 ref. With abstract. Published in "Schweissen und Schneiden," Feb 1975.

Future energy supplies require close cooperation between industry, science, and the state. This is illustrated by a few examples for the field of reactor research and development. Besides long-term conceptional problems, the "Forschungsprogramm Reaktordruckbehaelter" (research programme of reactor pressure vessels) which is in the process of preparation, is discussed within the framework of the reactor safety research program. (GE)

2164 (RISO-M-1769) DEPARTMENT OF REACTOR TECHNOLOGY. Annual Progress Report, 1 January–31 December 1974. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1975. 54p. Dep. NTIS (US Sales Only) $5.75.

Computer calculations are described related to: pressure vessels and their reliability, feedpumps, reliability calculations, radiation doses in nuclear power plants, reactor physics, simulation, heat transfer, accident analysis, core heat-up, emergency core cooling, containment, self-organizing control systems, CANDU type reactor studies, economics, etc. Fuel element development, fuel cladding failures and reactor accidents have been studied, often in cooperation with others. Finally, the use of Danish Reactor No. 1 for training, neutron radiography, pile oscillator experiments, Mossbauer effect studies, etc. is summarized. (LTN)

2165 NUCLEAR ENERGY AND SECONDARY ENERGY SOURCES. Schulten, R.; Kugeler, K.; Barnert, H. (Kernforschungsanlage, Juelich, Ger.). pp 148-158 of Physik: Grundlage der Technik. Weinheim, Ger.; Physik Verlag, GmbH (1974). (In German)

From 38th meeting of the German Physics Society; Nuernberg, Ger. (23 Sep 1974).

The energy situation in the German Federal Republic is discussed with respect to the market for fossil fuels, costs of nuclear energy, and natural gas. The concept of nuclear energy sources for production of electricity, coal gasification, energy source for initiation of chemical reactions, and decomposition of water into oxygen and hydrogen is considered. The high temperature reactor projects now under development in the German Federal Republic are discussed. (JSR)

2166 SITE AND SIZE OF FUTURE NUCLEAR DISTRICT HEATING PLANTS. Bonnenberg, H. (Bonnenberg und Drescher Ingenieurgesellschaft m.b.H., Juelich (F. R. Germany)). Atomwirt., Atomtech.; 20: No. 1, 33-35(Jan 1975). (In German).

In 1971 in the Federal Republic of Germany (FRG), only about 26% of primary energy fell to the share of electricity generating, and only about 12% of final energy to electricity consumption. The predominating heat consumption shows that nuclear energy must be applied also in the heat sector, in order to contribute considerably to a decrease of oil imports. In the FRG the rate of increase of district heating is 9.4% per year today, corresponding to a doubling time of 7.5 years. Considering consumptional points of concentration for electricity and for possible use of district heating it turns out that these regions are almost identical. Large nuclear heat power plants will be placed—at least up to 1990—at the same site of nuclear power plants already existing, planned, or under discussion. Distances of 20-30 km between nuclear power plants and places of dense population have become standard. In the future, nuclear heat power plants will be erected in these regions. (auth)

2167 NUCLEAR ENERGY MATURITY. The European Nuclear Conference, Paris, France, April 21–25, 1975. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc.; 20: 1-820(Apr 1975).

Included are 370 summaries of papers presented. Each paper is listed by title in NSA. (HDR)

For abstracts of individual papers see: 12, 80, 166, 167, 184–194, 210–215, 339–344, 437, 648, 741, 747–749, 781, 782, 794, 795, 999, 1000, 1191, 1307, 1351, 1352, 1457–1460, 1563–1568, 1576, 1585–1589, 2168–2172, 2183–2215, 2225–2255, 2264–2308, 2316–2324, 2350–2403, 2428–2431, 2665, 2666, 2702–2777, 2803, 2804, 2814–2817, 2826–2839, 2867–2869, 2871–2886, 2890–2897, and 2916–2920.

2168 ENEL'S DESIGN CRITERIA FOR STANDARDIZATION OF NUCLEAR POWER STATIONS. Sani, L.; Chiantore, G.; Velona, F. Trans. Amer. Nucl. Soc.; 20: 20-22(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2169 STANDARDIZATION OF NUCLEAR POWER PLANTS: ITS DIFFICULTIES IN THE INTERNATIONAL MARKET. Schatz, A.; Richard, C. C.; Stuermer, W. Trans. Amer. Nucl. Soc.; 20: 22-23(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2170 NEW TECHNIQUES FOR INSPECTION AND MAINTENANCE OF REACTORS. Vertut, J. Trans. Amer. Nucl. Soc.; 20: 177(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2171 PLANNING FOR TEST AND STARTUP OF NUCLEAR PLANTS. Stone, J. T. Trans. Amer. Nucl. Soc.; 20: 179-181 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2172 MATERIAL FOR SELF-INSTRUCTION AND A BASIC-PRINCIPLE SIMULATOR FOR REACTOR TRAINEES. Blomberg, P. E.; Gnosspelius, C. F. Trans. Amer. Nucl. Soc.; 20: 181-183 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2173 NUCLEAR ENERGY AND THE PUBLIC OPINION. Surrey, A. J. (Sussex Univ. (UK). Science Policy Research Unit). Arch. Energiewirt.; 28: No. 23, 1144-1148(Dec 1974). (In German).

From: Electr. Rev. (Aug 1974) v. 195(6) p. 202-203.

The British government, contrary to the CEGB who recommended American constructed light water reactors, has decided on the building of heavy water pressure tube reactors (SGHWR). It is recommended, in view of the different expert opinions and the missing evidence that "Whitehall knows everything better," that a large-scale public opinion inquiry be carried out. (GE)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 608, 2219, 2672, 2679, 2680, 2690, 2702, 2703, 2705, 2710, 2713, 2714, 2724, 2725, 2741, 2744, 2745, 2748, 2771, 2786, 2794, 2867, and 2900–2909.

2174 (AED-CONF-74-538-003) TECHNICAL EXPERIENCE IN THE WELDING AND MANUFACTURE OF PRIMARY COMPONENTS FOR LIGHT-WATER REACTORS. Cerjak, H.; Debray, W.; Pellkofer, D. (Kraftwerk Union A.G., Erlangen (F.R. Germany)). 1974. 23p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F.R. Germany (23 Oct 1974).

The great importance of welding techniques in considering the fabrication and testing expenditures as well as the safety assessment of reactor components is discussed. The faults occurring during fabrication due to welding could be controlled and solved by extensive investigations based on intensive cooperation of all positions taking part. By the quality control in the manufacture of additional materials and the quality control in the manufacture of reactor components, it is ensured that the welded components completely meet the set requirements. (GE)

2175 (AED-CONF-74-571-008) PLUTONIUM AVAILABILITY FROM LWR REPROCESSING IN THE FRG, EG AND USA. Baumgaertel, G.; Kraemer, R.; Kroebel, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Wiederaufarbeitung und Abfallbehandlung). 1974. 7p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

With abstract.

Most of recent studies on the strategies of LWR/FBR-populations make the assumption that the spent fuel from both reactor types can be reprocessed after proper cooling times in an intermediate storage. According to this assumption the plutonium produced in spent LWR- and FBR-fuel can be made available without undue time-delay for refabrication of FBR-fuel elements because there is enough reprocessing capacity available for both types of fuels, i.e., spent LWR- and FBR-fuel elements. However there is today no evidence for an equivalent reprocessing capacity within the next 10-15 years at least for a nuclear isolated FRG and certainly for the USA. This statement is derived by the necessary time interval of about 10 years between the conceptional design and hot operation at nominal capacity of a commercial reprocessing plant. Furthermore a number of drawbacks especially in the USA but also in Europe give rise to a more pessimistic prognosis in providing enough Pu for FBR-fuel fabrication. The present paper underlines this statement with respect to the special situation of the European Communities, the FRG and the USA and summerizes the most recent estimates on reprocessing capacities in these countries. The authors come to the conclusion that there is more benefit to save the reprocessed Pu for the demand of FBR-fuel fabrication than to recycle it in thermal reactors because of the serious gap in Pu supply for FBR-fuel fabrication which will ensue at the end of the next decade. (orig.)

2176 (AED-CONF-74-571-010) NUCLEAR CORE DESIGN AND PERFORMANCE OF KWU LIGHT WATER REACTORS WITH PLUTONIUM RECYCLE. Boehm, W.; Schlosser, G.; Spierling, H. (Kraftwerk Union A.G., Erlangen (F. R. Germany)). 1974. 18p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

Design considerations of fuel elements and reactor cores arising from the use of Pu are described. The distribution of the Pu elements plays a decisive role. Fuel management of the recycled Pu is discussed together with experience obtained in Pu recycling in the reactors Kahl, Lingen, Gundremmingen and Obrigkeim. (GE)

2177 (AED-CONF-74-571-013) RECYCLING OF PLUTONIUM IN THERMAL POWER REACTORS IN FRANCE. Guillet, H. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Service de Fabrication et d'Examens Radiometallurgiques). 1974. 6p. (In French). INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

With abstract.

Activities in the field of plutonium recycling in France are described together with experience gained with 3 types of Pu/U mixed oxide elements used in light water reactors and in critical experiments. Important plutonium recycle questions and problems such as availability and costs compared to uranium fuel are discussed. Questions on the future significance of plutonium recycle are also touched upon. (GE)

2178 (AED-CONF-74-571-017) SOME ECONOMIC CONSIDERATIONS ON PLUTONIUM RECYCLE IN LWR'S. Haubert, P.; Bairiot, H. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1974. 10p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

The economics of plutonium recycle are discussed considering uranium costs and fuel element manufacturing and reprocessing costs. The alternative between recycling and storage is investigated using estimates of the future availability of Pu. (GE)

2179 (AED-CONF-74-571-023) PRELIMINARY STEPS TOWARDS THE RECYCLING OF PLUTONIUM IN SWEDEN. Oesterlundh, C. G. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1974. 5p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

Based on the assessment of the plutonium yield in Sweden up to 1990, a report is given on the planning of the Pu recycling in Sweden's LWR. Pu storage is not planned as breeder reactors are not reckoned with in Sweden until 1990. Related to this, the state of the reactor physical investigations is also reported. (GE)

2180 (AED-CONF-74-571-024) 1974 STATUS REPORT ON THE CANADIAN PROGRAM FOR PLUTONIUM UTILIZATION IN THERMAL REACTORS. Slater, J. B.; MacEwan, J. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1974. 3p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

2181 (ORNL-NSIC-119) SELECTED BIBLIOGRAPHY ON PRESSURE VESSELS FOR LIGHT-WATER-COOLED POWER REACTORS (LWRs). Heddleson, F. A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 251p. Dep. NTIS $15.75.

Abstracts on LWR pressure vessels are arranged in the following categories: general, design, materials technology, fabrication techniques, inspection and testing, and failures. Author, keyword, and KWIC (keyword-in-content) indices are provided. (JWR)

2182 OPERATING EXPERIENCE WITH SATURATED STEAM CYCLE. Turbines, Steam Separators, Pipework. Haas, H. (Kraftwerk Union A. G., Muelheim an der Ruhr (F. R. Germany)). VGB Kraftwerkstechnik; 54: No. 12, 791-798(Dec 1974). (In German).

Following the commissioning of the first commercial light water reactor power stations at Stade and Wuergassen, operating experience with turbines, steam separators, and pipework of six saturated steam plants with an aggregate operating period of more than 240,000 hours is now available. As a whole the saturated steam turbines installed have proved satisfactory. Problems associated with the high moisture content in turbines and pipework can be regarded fundamentally as solved. (auth)

2183 DESIGN OF KWU STANDARD 1300-MW NUCLEAR POWER PLANTS WITH BOILING WATER REACTOR. Huettl, A. J. Trans. Amer. Nucl. Soc.; 20: 6-9(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2184 COMPUTER-AIDED DESIGN AND INSTALLATION OF CABLES FOR A NUCLEAR POWER PLANT. Cappelli, R.; Marescotti, G. Trans. Amer. Nucl. Soc.; 20: 42-44(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2185 STATUS OF MARK III DEVELOPMENT AND DESIGN PROGRAMS. Ianni, P. W.; McClelland, R. F. Trans. Amer. Nucl. Soc.; 20: 49-51(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2186 TURBINE ELECTROHYDRAULIC CONTROL TEST FOR CAORSO NUCLEAR POWER PLANT. de Benedetti, F.; Marescotti, G. Trans. Amer. Nucl. Soc.; 20: 53-56(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2187 DEVELOPMENT OF STEAM–WATER SEPARATION SYSTEMS FOR ASEA-ATOM BOILING WATER REACTORS. Sandstroem, J. E.; Oddving, B. Trans. Amer. Nucl. Soc.; 20: 61-63(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2188 OPERATING EXPERIENCE WITH MUEHLEBERG NUCLEAR POWER STATION (KKM) DURING THE FIRST TWO YEARS. Lutz, H. R. Trans. Amer. Nucl. Soc.; 20: 153-156 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2189 IMPLICATION OF FUEL PERFORMANCE ON THE PLANT OPERATION. Eickelpasch, N.; Seepolt, R.; Wolff, U. Trans. Amer. Nucl. Soc.; 20: 156-158(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2190 PROBLEMS CONNECTED WITH WATER CHEMISTRY IN THE PRIMARY CIRCUITS OF LIGHT-WATER REACTORS. Dolle, L.; Rozenberg, J.; Darras, R. Trans. Amer. Nucl. Soc.; 20: 189-190(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2191 STEAM GENERATORS: THE LONG ROAD TO MATURITY. Stevens-Guille, P. D.; Hare, M. G. Trans. Amer. Nucl. Soc.; 20: 190-192(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2192 REPORT CONCERNING REPLACEMENT OF FEEDWATER SPARGER IN THE OSKARSHAMN 1 REACTOR. Wassberg, R. Trans. Amer. Nucl. Soc.; 20: 211-212(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2193 UO_2–ZIRCALOY FUEL ELEMENTS: TESTING TO LIMITS, OPERATION WITH MOLTEN OXIDE. Bazin, J.; de

Contenson, G.; Vignesoult, N. Trans. Amer. Nucl. Soc.; 20: 232-235(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2194 OXIDE-CLADDING REACTIONS AND THEIR EFFECT ON WATER REACTOR FUEL COLUMN BEHAVIOR. Bazin, J.; Jouan, J.; Vignesoult, N. Trans. Amer. Nucl. Soc.; 20: 235-237(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2195 ACTIVITY AT CNEN FOR DEVELOPING NEW DESIGN CONCEPT FOR SPACER-GRID. Cali, G. P. Trans. Amer. Nucl. Soc.; 20: 239-242(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2196 LIGHT-WATER FUEL IRRADIATION IN THE PAT, FROM 1969–1974. Watteau, M.; Delafosse, J.; de Contenson, G. Trans. Amer. Nucl. Soc.; 20: 242-244(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2197 CEA LIGHT-WATER FUEL EXPERIMENTS IN THE BR3. de Contenson, G.; Lestiboudois, G.; Watteau, M. Trans. Amer. Nucl. Soc.; 20: 244-245(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2198 IRRADIATION BEHAVIOR OF PLUTONIUM FUELS FOR LWRS. Bairiot, H.; Gaube, M.; van Outryve d'Ydewalle, B. Trans. Amer. Nucl. Soc.; 20: 245-247(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2199 VERMONT YANKEE AND MAINE YANKEE INITIAL CORE FUEL PERFORMANCE. Beck, J. W.; Grube, R. M. Trans. Amer. Nucl. Soc.; 20: 248-249(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2200 GENERAL ELECTRIC FUEL PERFORMANCE UPDATE. JUDGE, F. D.; Williamson, H. E.; Weiss, D. T. Trans. Amer. Nucl. Soc.; 20: 249-251(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2201 IN-REACTOR EXPERIENCE WITH LWR FUEL. Manzel, R.; Stehle, H. Trans. Amer. Nucl. Soc.; 20: 253-256 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2202 UK LWR REACTOR PHYSICS CODES AND THEIR VALIDATION. Gibson, I. H.; Nash, G.; Halsall, M. J. Trans. Amer. Nucl. Soc.; 20: 329-331(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2203 FEEDBACK OF EXPERIENCE INTO THE APPLICATION OF CORE EVALUATION METHODS. Buono, A.; Gualandi, M. P.; Guidotti, R.; Marinelli, V.; Pistella, F.; Testa, G. Trans. Amer. Nucl. Soc.; 20: 331-333(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2204 FUEL MANAGEMENT AND CORE PERFORMANCE OF KWU LIGHT-WATER REACTORS. Dernedde, I.; Gruen, A.; Kilian, P. Trans. Amer. Nucl. Soc.; 20: 333-335(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2205 CORE-FOLLOW STUDY OF THE MUEHLEBERG BWR WITH FUEL MANAGEMENT SYSTEM. Rognon, J.; Wehrli, R.; Weigel, C.; Borresen, S.; Sauar, T. O.; Skardhamar, T. Trans. Amer. Nucl. Soc.; 20: 337-339(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2206 ISOTOPE CORRELATIONS: A NEW TOOL IN FUEL MANAGEMENT. Koch, L.; Brand, P.; Cricchio, A.; Sommer, D.; Zaffiro, B. Trans. Amer. Nucl. Soc.; 20: 339-341(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2207 IRRADIATION OF PLUTONIUM-BEARING FUEL ASSEMBLIES IN THE DODEWAARD BWR POWER PLANT. Deramaix, P.; Bonet, H.; Hubers, C.; Mostert, P. Trans. Amer. Nucl. Soc.; 20: 346-347(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2208 DEVELOPMENT AND APPLICATIONS OF A UTILITY-OPERATED FUEL CYCLE MODEL. Sandklef, S. Trans. Amer. Nucl. Soc.; 20: 354-355(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2209 SYSTEM OF COMPUTER CODES FOR REACTOR OPERATION ASSISTANCE. Bannella, R.; Felici, S.; Peroni, P.; Bonamico, M.; Bossola, S.; Piazza, G. Trans. Amer. Nucl. Soc.; 20: 355-357(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2210 CALCULATION OF LWR FUEL ELEMENTS CONTAINING BURNABLE POISONS AND PLUTONIUM. Maeder, C.; Paratte, J. M. Trans. Amer. Nucl. Soc.; 20: 359-361(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2211 NEPTUNE: A MODULAR SYSTEM FOR LIGHT-WATER REACTOR CALCULATION. Bouchard, J.; Kavenoky, A.; Reuss, P. Trans. Amer. Nucl. Soc.; 20: 365-367(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2212 ADVANCED IN-CORE FUEL MANAGEMENT FOR KWU LWRs: CRITERIA, PROCEDURES, RESULTS. Kollmar, W.; Schlosser, G.; Spierlig, H. Trans. Amer. Nucl. Soc.; 20: 386-387(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2213 PLUTONIUM RECYCLE IN LWRs: PROBLEMS AND PROSPECTS. Van Dievoet, J.; Fossoul, E.; Jonckheere, E.; Vanden Bemden, E. Trans. Amer. Nucl. Soc.; 20: 393-394(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2214 ATMOSPHERIC COOLING OF NUCLEAR POWER PLANTS: COMPARISON BETWEEN DRY AND WET COOLING. Mayor, J. C. Trans. Amer. Nucl. Soc.; 20: 455-457(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2215 RADWASTE REDUCTION TECHNIQUES FOR LWR GASEOUS EFFLUENTS. Stewart, J. E.; Khandhar, M. K. Trans. Amer. Nucl. Soc.; 20: 649-654(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2216 IMPACT OF ZONING ON THE SITING OF THE SKAGIT NUCLEAR POWER PROJECT. Stimac, M. V. (Puget Sound Power and Light Co., Bellevue, WA). Nucl. Technol.; 25: No. 4, 722-723(Apr 1975).
The experience of the Puget Sound Power and Light Company in the siting of the Skagit Nuclear Power Project in Skagit County, Washington, has shown that local zoning can have a major impact on project planning and scheduling. Zoning was identified as an issue early, and resolution was eventually brought about after more than a one-year delay by the execution of a rezone contract. A part of the contract was an agreement between the Company and Skagit County specifying more than 40 provisions on which the rezone depended. This experience demonstrated that the achievement of earlier plant availability dates and the success of the "predesignated site" may well depend on early identification and resolution of such potential key problem issues as zoning. 5 references. (auth)

2217 MINIATURE FISSION CHAMBERS FOR LIGHT-WATER REACTOR CONTROL. Duchene, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 7-11 (Sep 1974). (In French).
Miniature fission chambers are widely used to measure reactor core fluence rates, especially in light-water stations. These detectors are subjected to severe stresses and the main problem is to preserve the characteristics of the apparatus in high fluences. A miniature fission chamber working in direct current is described. It is designed for core measurements in PWR stations, with mobile system at present being developed in France at the request of the FRAMATOME Company by the joint effort of the CEA and the R. T. C. constructor. (FR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 1332, 2174–2179, 2181, 2182, 2190, 2191, 2193, 2194, 2196–2199, 2201–2204, 2206, 2209, 2211–2215,

2217, 2420, 2671, 2672, 2675, 2677, 2703, 2704, 2709–2711, 2713, 2714, 2717, 2719, 2721, 2723–2725, 2735–2740, 2742, 2743, 2746–2749, 2768, 2769, 2771, 2864, 2869, 2900–2911, and 2916.

2218 (AED-CONF-74-497-003) CHEMICAL MEASURES IN THE START-UP OF NUCLEAR POWER PLANTS WITH PWRS. Gebauhr, W.; Graemer, G.; Olijve, J. G.; Riess, R.; Schroeder, H. J. (Kraftwerk Union A. G., Erlangen (F.R. Germany)). 1974. 15p. (In German). INIS.

From VGB conference "Chemistry in the Power Plant 1974"–VGB feed water conference 1974; Essen, F.R. Germany (29 Oct 1974).

Start-up or putting into operation should be understood as the time period from the pressure test of the primary system up to the commissioning of the plant. The object of the chemical measures is to prevent the occurrence of corrosion and its subsequent effects in order to ensure a long-term integrity of all equipment. Along with these measures are specifications of the coolant for the operation, provision of instructions for the surface protection, purification of the coolant, optimum planning in the employing and training of personnel, detailed schedule planning in the framework of the whole start-up operation and early acquisition of the necessary operating media. The experience gathered in the start-up of the nuclear power plants KWO, KKS, KCB (Borssele) and Biblis A is given. (GE)

2219 (AED-CONF-74-571-011) EXPERIENCE OF BELGONUCLEAIRE ON PLUTONIUM RECYCLE CONFIGURATIONS IN LWR'S. Deramaix, P.; Bairiot, H.; Vandenberg, C. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1974. 7p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

Plutonium recycle in light-water reactors can be realized by constituting assemblies in which the majority of the rods contain plutonium fuel, by dispersing the plutonium rods into most assemblies, or by using Pu-island assemblies in which plutonium rods are concentrated in the central part of the reload assemblies. The choice depends on: the fuel cycle policy adopted by the Utility; the inherent flexibility of the core (e.g., the control rod worths); and the know-how accumulated by the fuel supplier. Experience gained by Belgonucleaire indicates that the island concept is best suited for reactors with cruciform control rods (BWR's and first generation PWR's) and also that the all-Pu concept has advantages in the frame of a RCC reactor. There is, however, no universal solution, and the decision depends on a choice to be made by the Utility taking into consideration its own constraints and the experience of the manufacturer providing the reload fuel. (GE)

2220 (NYO-3144-75) OPERATION REPORT NO. 75-2 FOR THE MONTH OF FEBRUARY 1975. (Connecticut Yankee Atomic Power Co., Haddam (USA)). 1975. 29p. Dep. NTIS $4.50.

Routine operations and maintenance during February are summarized. Data on water chemistry, occupation radiation exposure, and radioactive effluents are presented. (JWR)

2221 CONSTRUCTION AND FABRICATION OF THE FUEL ELEMENT STORAGE TANKS WITHIN THE REACTOR CONTAINMENT OF TULLNERFELD NUCLEAR POWER PLANT, AUSTRIA. Haupt, L.; Nies, D.; Nussbaumer, H. Bautechnik; 51: No. 6, 192-200(Jun 1974). (In German).

A detailed description is given of the first application of the lifting technique in the nuclear power plant construction for the erection and installation of the fuel element storage tanks (storage, spent fuel pit, flow system) in the reactor containment buildings. (HP/LH)

2222 POSSIBILITIES AND PROBLEMS OF IN-LINE-MONITORING OF THE PRIMARY COOLANT OF PRESSURIZED WATER REACTORS. Neeb, K. H.; Hiller, S. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). VGB Kraftwerkstechnik; 54: No. 12, 821-825(Dec 1974). (In German).

Two examples of in-line methods of measurement being developed, together with their possibilities and problems, are discussed in more detail: boric acid analysis by neutron absorption measurement and radiochemical single-nuclide analysis by in-line γ spectrometry. The computer evaluation of the γ spectra obtained from in-line measurement is briefly discussed. (auth)

2223 USE OF ON-LINE PROGRAMMABLE CALCULATORS IN NUCLEAR POWER PLANT LABORATORIES. Birch, M. L. (Duke Power Co., Charlotte, NC); Hearn, R. A.; Walker, D. M. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 711-717(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

On-line programmable calculator systems and programs have been developed to meet health physics and radiochemistry needs at a three-unit PWR nuclear plant. The system provides automatic energy and efficiency calibration, and automatic quantitative radionuclide analysis for liquid and gaseous reactor effluent releases, environmental samples, and whole body counting data. Programmable calculator systems are also in use at other power-reactor facilities for personnel dosimetry record keeping, TLD information processing, and storage of data for scheduled AEC reports. (auth)

2224 PWR PROTECTION SYSTEM: PRESENT AND FUTURE. von Haebler, D. (Kraftwerk Union, Erlangen, Ger.); Meijer, C. H. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 784-797(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

In a nuclear power generating station, the system used to protect the reactor and its containment is the plant protection system. The pressurized-water-reactor (PWR) protection systems encompass all electrical and mechanical devices and circuitry (from sensors to actuated device input terminals) involved in generating those signals associated with the protective function. These signals include actuation signals for the Reactor Protection System (RPS) and Engineered Safety Features System (ESFS) such as Safety Injection Actuation System, Containment Spray Actuation System, Main Steam Isolation System, Auxiliary Feedwater Actuation System, and Recirculation Actuation System. The present status and future development of the Plant Protection Systems utilized by Combustion Engineering, Inc. (C-E) and Kraftwerk Union (KWU) for their Pressurized Water Reactors are reviewed. The latest techniques of signal processing, logic design, reactor trip and engineered safety features actuation circuitry, automatic testing, isolation and interfacing, are discussed. Current system design criteria, which as a result of the dynamic national and international licensing atmospheres influence system design philosophies, are highlighted. 28 references. (auth)

2225 DESIGN FEATURES OF SYSTEM 80: C–E's STANDARD 3800-MW(th) PWR. Bevilacqua, F. Trans. Amer. Nucl. Soc.; 20: 3-6(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2226 DESIGN OF STANDARD 1300-MW NUCLEAR PLANT WITH PRESSURIZED WATER REACTOR. Martin, A.; Gruener, W.; Preuss, H. J. Trans. Amer. Nucl. Soc.; 20: 11-13(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2227 EVOLUTION OF WESTINGHOUSE PWR LEADING UP TO THE 3000-MW(th) REACTOR MODEL. Tiler, W. P.; Katz, L. R. Trans. Amer. Nucl. Soc.; 20: 13-17(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2228 DESIGN DIFFERENCES BETWEEN FRAMATOME AND WESTINGHOUSE PWR POWER PLANTS. Py, J. P. Trans. Amer. Nucl. Soc.; 20: 17-18(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2229 STONE AND WEBSTER REFERENCE NUCLEAR POWER PLANT. Kennedy, W. J. L.; Gans, D. Jr.; Drotleff, W. C. Trans. Amer. Nucl. Soc.; 20: 18-20(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2230 SMALL AND AVERAGE POWER NUCLEAR BOILERS TO PRODUCE ELECTRICITY OR BOTH STEAM/ELECTRICITY. Martinot; Porte; Sautiez. Trans. Amer. Nucl. Soc.; 20: 29-33 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2231 LAST DEVELOPMENTS OF NUCLEAR FUEL FOR PWR REACTORS. Nakazato, S.; LeClercq, J. Trans. Amer. Nucl. Soc.; 20: 34-37(Apr 1975).

2232 LARGE NOZZLE BELT FORGINGS FOR PWR 1200 MW(e). Debray, W.; Cerjak, H.; Onodera, S.; Tsukada, H.; Suzuki, K. Trans. Amer. Nucl. Soc.; 20: 37-39(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2233 NEW CONTAINMENT CONCEPT FOR LIGHT-WATER REACTORS: DOUBLE SHIELD WITHOUT BARRIER SEAL. Costaz, J. L. Trans. Amer. Nucl. Soc.; 20: 51-52(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2234 VIBRATION BEHAVIOR OF PWR REACTOR INTERNALS. Assedo, R.; Dubourg, M.; Livolant, M. Trans. Amer. Nucl. Soc.; 20: 66-69(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2235 STARTUP AND INITIAL OPERATION OF OCONEE 1, 2, AND 3. Hennicke, H. Trans. Amer. Nucl. Soc.; 20: 149-151 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2236 CHARACTERISTICS OF X-Y XENON OSCILLATIONS AT INDIAN POINT UNIT 2. Rutgers, E. G.; Kerr, R. A.; Paccione, R. J. Trans. Amer. Nucl. Soc.; 20: 171-173(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2237 STAFFING AND TRAINING OF BRAZIL'S FIRST NUCLEAR POWER PLANT. Costa, M.; de Oliveira, E. C.; Pellet, M. R. Trans. Amer. Nucl. Soc.; 20: 177-179(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2238 RADIOACTIVE CONTAMINATION IN PWR PRIMARY CIRCUITS. Frejaville, G.; Beslu, P.; Marchal, A.; Samuel, T. Trans. Amer. Nucl. Soc.; 20: 186-187(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2239 CORRELATION OF PWR STEAM GENERATOR TUBE FAILURES WITH THERMAL-HYDRAULIC CHARACTERISTICS. Hausermann, R. Trans. Amer. Nucl. Soc.; 20: 192-195(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2240 STEAM SIDE WATER CHEMISTRY IN PWR STEAM GENERATORS. Samuel, T. Trans. Amer. Nucl. Soc.; 20: 195-196(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2241 EDDY-CURRENT EXAMINATION OF BEZNAU STEAM GENERATOR TUBING. Sandona, E. Trans. Amer. Nucl. Soc.; 20: 196-200(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2242 FUEL PERFORMANCE IN ENEL POWER STATIONS. Fiorentino, F.; Donega, G. Trans. Amer. Nucl. Soc.; 20: 205 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2243 PWR FUEL OPERATING EXPERIENCE AND PERFORMANCE EVALUATION PROGRAM. Traccucci, R. Trans. Amer. Nucl. Soc.; 20: 256-257(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2244 UTILITY OWNER EXPERIENCE IN THE FUEL MANAGEMENT OF THE SENA REACTOR. Charransol, P. Trans. Amer. Nucl. Soc.; 20: 335-337(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2245 EXPERIMENTAL DATA AS REFERENCE FOR PLUTONIUM RECYCLING IN THE SENA REACTOR. Basselier, J.; DeBrue, J.; Leenders, L.; Van Den Broeck, H. Trans. Amer. Nucl. Soc.; 20: 344-346(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2246 CORE MODELIZATION AND COMPUTATIONAL ALGORITHMS FOR PWR CORE MANAGEMENT CODES. Melice, M.; Hunin, C. Trans. Amer. Nucl. Soc.; 20: 367-369(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2247 PWR FUEL LOADING OPTIMIZATION. Martinet, M.; Santamarina, A. Trans. Amer. Nucl. Soc.; 20: 371-374 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2248 IN-CORE FUEL MANAGEMENT SCHEMES ASSOCIATED WITH PWR STARTUP DEFERRAL. Koskinen, E.; Silvennoinen, P. Trans. Amer. Nucl. Soc.; 20: 376-378(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2249 PLUTONIUM DEMONSTRATION ASSEMBLIES IN THE CNA CORE. Romain, J. L. Trans. Amer. Nucl. Soc.; 20: 378-380(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2250 PLUTONIUM RECYCLE CONCEPTS FOR RCC-TYPE PWRS. Bonet, H.; Charlier, A.; Deramaix, P.; Vandenberg, C. Trans. Amer. Nucl. Soc.; 20: 380-382(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2251 SENSITIVITY ANALYSIS OF PWR AND HTGR FUEL CYCLE COSTS. Guentay, S. Trans. Amer. Nucl. Soc.; 20: 419-420(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2252 QUALITY ANALYSIS IN PRESSURIZED WATER REACTOR FUEL. Darolles, J. F. Trans. Amer. Nucl. Soc.; 20: 572-574(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2253 TRENDS FOR PWR RADWASTE TREATMENT STATIONS ON BASIS OF PRESENT EXPERIENCE. Mergan, L.; Gallois, G.; Mestrez, J.; Storrer, J. Trans. Amer. Nucl. Soc.; 20: 646-649(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2254 POTENTIAL MARKET AND CHARACTERISTICS OF LOW-TEMPERATURE REACTORS. Lerouge, B.; Aubert, R. Trans. Amer. Nucl. Soc.; 20: 733-734(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2255 INTEGRATED PRESSURIZED WATER REACTOR FOR POWER GENERATION AND DESALINATION. Harde, R.; Breyer, W.; Holling, E. Trans. Amer. Nucl. Soc.: 20: 734-736(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 88, 441, 2251, 2687, 2700, 2731–2734, 2771, 2784, and 2865.

2256 (AED-CONF-74-571-016) PLUTONIUM IN HIGH TEMPERATURE REACTORS. Hansen, U. (Organization for Economic Co-Operation and Development, Winfrith (UK). High Temperature Reactor Project). 1974. 6p. INIS.
From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).
A review on the investigations into various organizations of different variants of the plutonium re-cycling is given as is shown by some types of high-temperature reactors. Furthermore, a few Pu experiments are described which concern fuel fabrication, irradiation, and reactor lattices. (GE)

2257 (EUR-5256f) THERMAL PERFORMANCES OF AN INSULATING STRUCTURE FOR A REACTOR VESSEL. Aranovitch, E.; Crutzen, S.; Le Det, M.; Denis, R. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 55p. (In French). Dep. NTIS (US Sales Only) $5.75. EUR FB 70,-.
This report describes the thermal and technological tests performed on a multilayer thermal insulation system for high temperature gas reactors. It includes the description of test facilities, global tests, interpretation of data, and technological tests. Results obtained make it possible to predetermine with a satisfactory precision thermal performances under various nominal conditions. (auth)

2258 (JUL-1141-RG) NUMERICAL INVESTIGATIONS FOR A 2700 MW_{th}-OTTO-PEBBLE-BED REACTOR UNDER OPERATING CONDITIONS OF A HELIUM-TURBINE POWER PLANT. Ruetten, H. J. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Dec 1974. 89p. (In German). Dep. NTIS (US Sales Only) $7.50.
Thesis. Submitted to Technische Hochschule Aachen, West Germany.
A high-temperature reactor with a direct helium cycle requires an especially small release of fission products to enable the maintenance of the turbine and of the hot gas tubes. This requires rather low fuel element temperatures. This fact, in consideration to the high turbine inlet gas-temperature (850°C) and to the relatively small gas temperature rise in the core (410°C), demands a special thermodynamic and neutron-physical design of the reactor. An axial power profile, which is particularly favorable to the thermodynamics, can be achieved in an "OTTO"-pebble-bed reactor. The neutron-physical and thermodynamic design of dif-

ferent pebble-bed cores are presented. They are optimized with regard to temperatures of gas and fuel elements, which are favorable to a direct cycle, respectively to low costs for the fuel cycle. In this connection various technical and constructive conditions, especially concerning to the outer reflector, are considered. The initial core, running-in period, reactor control, the influence of a modified fuel-element-geometry on the fuel temperature, and the spatial power profile as a function of the flow-scheme of the pebbles are investigated. (auth)

2259 (ORNL-TM-4397(Add.)) IRRADIATION TEST OF CANDIDATE HTGR RECYCLE FUELS IN THE H-1 AND H-2 CAPSULES: ADDENDUM. Olstad, R. A.; Long, E. L. Jr. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 14p. Dep. NTIS $4.00.

Two H-1 and H-2 capsule fuel rods, each containing Biso-coated ThC_2 and Triso-coated UC_2 particles, were examined metallographically after the examination of these capsules had been reported. Rods H-2-5 and H-1-9 operated at maximum center-line temperatures of approximately 1400°C and 1720°C, respectively. The metallography of rod H-2-5 revealed about 50 mu m of ThC_2 kernel migration, no UC_2 kernel migration, some fission product attack of the SiC coatings, and graphitization of the inner pyrocarbon coatings at the cold side of the UC_2 particles. Rod H-1-9 exhibited extensive ThC_2 kernel migration (approximately 250 mu m), no migration in most UC_2 particles, and considerable fission product attack of the SiC coatings. (auth)

2260 (ORNL-TM-4542) TEMPERATURE OF LOOSE COATED PARTICLES IN IRRADIATION TESTS. Conlin, J. A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

An analysis is presented of the temperature of a monolayer bed of loose High-Temperature Gas-Cooled Reactor (HTGR) type fissioning fuel particles in an annular cavity. Both conduction and radiant heat transfer are taken into account, and the effect of particle contact with the annular cavity surfaces is evaluated. Charts are included for the determination of the maximum surface temperature of the particle coating for any size particle or power generation rate in a fuel bed of this type. The charts are intended for the design and evaluation of irradiation experiments on loose beds of coated fuel particles of the type used in HTGRs. Included in an Appendix is a method for estimating the temperature of a particle in circular hole. (auth)

2261 (WANL-TR-6677) TRIP REPORT TO OAK RIDGE NATIONAL LABORATORY. Fatzer, E. G.; Holmgren, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Oct 1971. 10p. Dep. NTIS $4.00.

A meeting for ORNL personnel to brief Westinghouse personnel on the present status and developments in High Temperature Gas Cooled Reactors was held at Oak Ridge September 29 and 30 under the auspices of P. Kasten, Director, Gas Cooled Reactors. The review covered the gas cooled reactors previously constructed in Europe and the U. S., fuel beads and pyrocarbon coatings, graphite requirements and performance, fuel re-cycle, fission products, safety and heat exchanger requirements and economic assessments. (auth)

2262 THE OBERHAUSEN HEAT-AND-POWER STATION WITH HELIUM TURBINE. Bammert, K. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Stroemungsmaschinen). Kertechnik; 17: No. 1, 9-17(Jan 1975). (In German and English).

December 19th, 1974 saw the commissioning of the Oberhausen heat-and-power station, which is equipped with a helium turbine. The plant is rated for a net electrical output of 50 MW and a heat output of 53.5 MW. This helium power plant, which is the first of its kind in the world, has to fulfil a double function. On the one hand it is to supply the citizens with power and heating, and on the other hand it is to furnish the operating results which permit the development of the high-temperature reactor with helium turbine to be furthered. Therefore, the turbo machines and heat-exchanging apparatus have been designed to meet such requirements as arise in nuclear helium turbine plants of high output. After beginning of operation it is intended to take such measurements during normal operation of the power plant as permit conclusions about the long-term, control and operating behavior of the plant as a whole and of each of its major components. (auth)

2263 HTGR STARTUP EXPERIENCE AT FORT ST. VRAIN. Block, G. A. (General Atomic Co., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 805-807(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Fort St. Vrain Unit 1, a 330-MW(e) HTGR being built by General Atomic for the Public Service Co. of Colorado, is located about 40 miles north of Denver. Construction began in 1968 and fuel was loaded under the first phase of the two-phase license in January 1974. The reactor has been critical a number of times to perform physics tests, but has been restrained until recently from producing any sensible heat by the restrictions of the second phase of the license. All prerequisites to the second and last phase of the license were satisfied on November 14 and the 40-year, full-power license went into effect. Since then, hot physics tests have been performed and feedwater has been introduced into the steam generators. All prerequisite testing is complete and feedwater chemistry is within specification for steam generator boilout. The plant is presently shut down and in a standby condition while the backup pelton wheels on the four primary helium circulators are being changed to an improved material. Upon completion of this change, now scheduled for the end of January, the rise-to-power program will begin. (auth)

2264 STEAM GENERATING PLANT FOR THE ADVANCED GAS-COOLED REACTOR. Stead, R. Trans. Amer. Nucl. Soc.; 20: 100-102(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2265 DESIGN AND FABRICATION OF HELICALLY COILED BOILERS FOR GAS-COOLED REACTORS. Worley, N. G.; Perrin, A. J. Trans. Amer. Nucl. Soc.; 20: 102-104(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2266 HIGH-TEMPERATURE REACTOR STEAM GENERATOR DESIGN AND SYSTEM IMPLICATIONS. Bachmann, U. Trans. Amer. Nucl. Soc.; 20: 104-106(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2267 EXPERIENCE OF DESIGN AND CONSTRUCTION OF PCPVs FOR AGRs AND HTRs IN EUROPE. Schaefer, K.; Schwiers, H. G.; Brunton, J. D.; Crowder, R. Trans. Amer. Nucl. Soc.; 20: 106-113(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2268 DESIGN OF GAS-COOLED REACTOR COMPONENTS IN A NOISE ENVIRONMENT. Parker, J. V.; Blairs, W. Trans. Amer. Nucl. Soc.; 20: 113-116(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2269 INSTRUMENTATION OF HTRs AND SAFETY-RELATED REQUIREMENTS. Kaiser, G. E. Trans. Amer. Nucl. Soc.; 20: 116-119(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2270 REFERENCE DESIGN OF THE HTGR NUCLEAR GAS-TURBINE POWER PLANT. Hodzic, A.; Haferkamp, D.; Arndt, E.; Endres, F. Trans. Amer. Nucl. Soc.; 20: 119-120(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2271 PLAYGAS: COMPUTER CODE FOR THE TRANSIENT ANALYSIS OF NUCLEAR GAS-TURBINE POWER PLANTS. Dupont, J. F.; Cina, G.; Dang, M. Trans. Amer. Nucl. Soc.; 20: 120-122(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2272 INVESTIGATIONS FOR THE INNER INSULATION OF THE HOT GAS DUCTS IN AN HHT PLANT. Achenbach, E.; Broeckerhoff, P.; Scholz, F. Trans. Amer. Nucl. Soc.; 20: 122-125(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2273 AVR-REACTOR: A CONTRIBUTION TO THE DEVELOPMENT OF THE HTR. Gilli, R.; Krueger, K.; Dering, W. Trans. Amer. Nucl. Soc.; 20: 169-171(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2274 RADIOLYTIC CORROSION OF GRAPHITE IN THE BUGEY REACTOR. Blanchard, R.; Koch, C.; Laurent, J. M. Trans. Amer. Nucl. Soc.; 20: 183-184(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2275 COOLANT CHEMISTRY IN HIGH-TEMPERATURE REACTORS UNDER NORMAL AND ACCIDENT CONDITIONS. Nieder, R.; Wischnewski, R. Trans. Amer. Nucl. Soc.; 20: 185-186(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2276 LOAD-FOLLOWING CAPABILITIES OF AGR FUEL PINS. Gallie, R. R.; Greenough, G. B.; Hughes, H. Trans. Amer. Nucl. Soc.; 20: 224-226(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2277 METALLIC FISSION PRODUCT MIGRATION IN COATED FUEL PARTICLES. Stoever, D.; Neef, N.; Roehrig, H. D. Trans. Amer. Nucl. Soc.; 20: 266-268(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2278 STATE AND DEVELOPMENT OF HTGR FUEL ELEMENTS IN THE FRG. Balthesen, E.; Ehlers, K.; Huschka, H.; Nickel, H. Trans. Amer. Nucl. Soc.; 20: 268-270(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2279 OPERATION CAPABILITY OF STANDARD HTR FUEL AT HIGH TEMPERATURE. Gaube, M.; Aerts, L.; Thomson, J. M.; Vangeel, J.; Van de Velde, J.; Van Loon, C. Trans. Amer. Nucl. Soc.; 20: 270-272(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2280 DESIGN OF HTR FUEL FOR ENDURANCE. Cunningham, C.; Knowles, A. N. Trans. Amer. Nucl. Soc.; 20: 272-274(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2281 INITIAL PERFORMANCE AND RELATED QUALITY ASSURANCE OF FORT ST. VRAIN FUEL. Ross, S. R.; Warembourg, D.; Hoffman, B. L.; Scarborough, J. C. Trans. Amer. Nucl. Soc.; 20: 275-278(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2282 MAGNOX FUEL ELEMENT ENDURANCE STUDIES: A REVIEW OF CEGB EXPERIENCE. Hines, G. F. Trans. Amer. Nucl. Soc.; 20: 278-279(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2283 20 YEARS EXPERIENCE IN METALLIC NATURAL URANIUM FUEL CYCLE. Boudouresques, B.; Le Duigou, A.; Le Noc, J. P.; Couture, P. Trans. Amer. Nucl. Soc.; 20: 279-282(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2284 TECHNIQUES OF FUEL MANAGEMENT IN THE CEGB'S GAS-COOLED REACTORS. Gore, J. E.; Silverleaf, D. J.; Vaughan, R. I. Trans. Amer. Nucl. Soc.; 20: 357-359 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2285 SPACE-DEPENDENT POWER TRANSIENTS IN HIGH-TEMPERATURE PEBBLE-BED REACTORS. Froehling, W.; Lauer, A.; Schwiegk, H. J. Trans. Amer. Nucl. Soc.; 20: 369-371(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2286 HTGR FUEL CYCLE STATUS IN THE USA. Dahlberg, R. C.; Turner, R. F.; Lane, R. K.; Jackson, D. M.; Finkbeiner, R. Trans. Amer. Nucl. Soc.; 20: 413-414(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2287 STUDY OF HIGH-TEMPERATURE REACTOR FUEL CYCLES. Brisbois, J.; Couture; Roudier; Sartorius. Trans. Amer. Nucl. Soc.; 20: 414-416(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2288 HIGH-TEMPERATURE REACTOR IN THE FUTURE FUEL MARKET. Gutmann, H.; Hansen, U.; Larsen, H.; Neef, H. J. Trans. Amer. Nucl. Soc.; 20: 416-418(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2289 ALTERNATIVE FUEL CYCLES FOR THE PEBBLE-BED REACTOR. Teuchert, E.; Maly, V. Trans. Amer. Nucl. Soc.; 20: 418-419(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2290 CONTINUOUS WORKING PROCESS FOR THE PRODUCTION OF ThO_2 AND $(Th,U)O_2$ FUEL KERNELS. Zimmer, E.; Naefe, P.; Ringel, H. Trans. Amer. Nucl. Soc.; 20: 591-593(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2291 FABRICATION AND PROPERTIES OF MOLDED BLOCK FUEL ELEMENTS FOR HTGRs. Hrovat, M.; Huschka, H. Trans. Amer. Nucl. Soc.; 20: 603-605(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2292 MOLDED GRAPHITES FOR PRISMATIC HTR FUEL BLOCKS. Moore, R. W. Trans. Amer. Nucl. Soc.; 20: 605-607(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2293 HTGR FUEL CYCLE STATUS IN THE FEDERAL REPUBLIC OF GERMANY. Tillessen, U.; Merz, E.; Kaiser, G. Trans. Amer. Nucl. Soc.; 20: 636-639(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2294 HTGR FOR NUCLEAR PROCESS HEAT APPLICATIONS. Quade, R. N.; Meyer, L. Trans. Amer. Nucl. Soc.; 20: 699-702(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2295 HTR-SYSTEM FOR NUCLEAR PROCESS HEAT APPLICATION. Harde, R.; Mueller, H. W. Trans. Amer. Nucl. Soc.; 20: 702-703(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2296 MOLTEN SALT REACTORS FOR HIGH TEMPERATURES. Faugeras, P.; Lecocq, A.; Blum, J. M.; Grenon, M. Trans. Amer. Nucl. Soc.; 20: 703-704(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2297 PILOT PLANT EVA: NUCLEAR ENERGY AT HIGH TEMPERATURE FOR CHEMICAL PROCESSES. Harth, R.; Hoehlein, B. Trans. Amer. Nucl. Soc.; 20: 711-712(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2298 HYDROGASIFICATION OF COAL WITH NUCLEAR HEAT. Teggers, H. Trans. Amer. Nucl. Soc.; 20: 712-715 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2299 STEAM GASIFICATION OF COAL USING HEAT FROM HTRs. Juentgen, H.; van Heek, K. H.; Duerrfeld, R.; Feistel, P. P. Trans. Amer. Nucl. Soc.; 20: 715-717(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2300 HYDROGEN PRODUCTION BY WATER SPLITTING: CLOSED CYCLES OF CHEMICAL REACTIONS. De Beni, G. Trans. Amer. Nucl. Soc.; 20: 717-719(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2301 MAIN OUTLINE OF THE DEVELOPMENT OF HYDRO-NUCLEAR SYSTEMS FOR ENERGY DISTRIBUTION. Luxo, A.; Vendryes, G. Trans. Amer. Nucl. Soc.; 20: 719(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2302 METHOD OF EVALUATION OF NUCLEAR THERMO-CHEMICAL PROCESSES FOR WATER DECOMPOSITION. Broggi, A.; Beghi, G. (EURATOM, Ispra, Italy). Trans. Amer. Nucl. Soc.; 20: 719-721(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2303 HYDROGEN FROM NUCLEAR ENERGY: CONCEPTS AND ECONOMY. Barnert, H. (Nuclear Research Center, Juelich, Ger.). Trans. Amer. Nucl. Soc.; 20: 721-723(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2304 OVERALL EFFICIENCIES FOR NUCLEAR HEAT UTILIZATION IN THE PRODUCTION OF HYDROGEN BY WATER DECOMPOSITION. Courvoisier, P.; Lecoanet, A.; Pottier, J.; Roth, E. Trans. Amer. Nucl. Soc.; 20: 723-725(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2305 STUDY OF THE COUPLING OF AN ADVANCED HTGR WITH A WATER-SPLITTING PLANT. Esteve, B.; Malherbe, J. Trans. Amer. Nucl. Soc.; 20: 725-727(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2306 ENHANCED HEAT TRANSFER OF FUEL AT LOW REYNOLDS NUMBER. Hishida, M.; Okamoto, Y.; Kawamura, H.; Hanawa, J. Trans. Amer. Nucl. Soc.; 20: 756-758(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2307 VERIFICATION OF SUBCHANNEL ANALYSIS COMPUTER CODES BY A FULL-SCALE EXPERIMENT. Markoczy, G.; Huggengerger, M. Trans. Amer. Nucl. Soc.; 20: 758-761 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2308 THERMAL-HYDRAULIC PERFORMANCE OF SOME RIBBED SURFACES AND THEIR CHOICE FOR GCFR. Hudina, M. Trans. Amer. Nucl. Soc.; 20: 761-764(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2309 WATER-COOLED GRAPHITE-MODERATED PRESSURE TUBE REACTORS IN THE USSR. Wenzel, P.; Zabka, G. (Inst. for Power Stations, Berlin). Kernenergie; 17: No. 12, 361-367(Dec 1974). (In German).
The recent status and development trends of the water-cooled, graphite-moderated, pressure tube type reactors in the USSR are discussed. Emphasis is on the description of the Leningrad nuclear power plant with the saturated-steam reactors of RBMK-1000 type and the fueling régime of this reactor type. The comparison between pressure tube reactors and the pressurized-water ones shows the main differences between these two directions of development. (auth)

2310 HTR: SECOND GENERATION ATOMIC REACTOR, Economic, Safe, and Environmentally Acceptable for Power Production and Industrial Process Heat. Boeye, K. (Central Institutt for Industriell Forskning, Oslo). Tek. Ukebl.; 122: No. 7, 13-16(13 Feb 1975). (In Norwegian).

2311 FATIGUE OF THE NUCLEAR FUEL CENTERING DEVICES. Millet, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles); Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). pp 215-236 of La Fatigue. Relations Entre Aspects Metallurgiques et Mechaniques. Saclay, France; Institut National des Sciences et Techniques Nucleaires ([nd]). (In French).
From 15th colloquium on metallurgie; Saclay, Franch (21 Jun 1972).
The flow of coolant fluid can cause fatigue-induced breaking of the centering devices which hold the natural uranium-graphite-gas reactor fuel elements in position in the channel. In order to solve the problem this phenomenon was analyzed by fatigue tests under alternate, bending stresses on Mg-Zr alloy samples at 350 deg and 450 deg C, together with stress measurements in a loop. For easier analysis of the results the fatigue test programme was adapted to the possibilities of loop measurements; for example, the specimen used is a piece of the centering device and the stresses are defined by the deformation value measured on the outer fibre. The results obtained are presented (Woehler curve and scattering) and interpreted taking into account the random nature of the fatigue stresses measured on the centers. (FR)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 995, 2180, 2720, 2775, 2791, 2865, and 2898.

2312 (AED-CONF-74-571-001) URANIUM-PLUTONIUM MIXED-OXIDE FUEL FABRICATION FOR THE DEUTERIUM CRITICAL ASSEMBLY "DCA" IN JAPAN. Akutsu, H.; Mutoh, T.; Kawashima, K.; Naruki, K. 1974. 36p. INIS.
From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).
With abstract.
The Plutonium Fuel Fabrication Facility of the Japanese Power Reactor and Nuclear Fuel Corporation is devoted to production of Pu/U mixed oxide fuel elements for FBR and ATR projects and in particular for the prototype heavy water reactor FUGEN which is to become critical in 1976. A total of 92 fuel assemblies consisting of 3 different types of fuel rods and a total of 2,600 rods were fabricated for the Deuterium Critical Assembly in which reactor physics investigations were carried out prior to beginning operation of the FUGEN reactor. Fuel fabrication experience and data which form the basis of extended planning are described. (GE)

2313 (RISO-M-1773) EXAMPLE OF BURN UP CALCULATIONS IN THREE DIMENSIONS FOR A CANDU CORE. Hoejerup, C. F.; Petersen, T. (Danish Atomic Energy Commission, Risoe, Research Establishment). 18 Dec 1974. 13p. Dep. NTIS (US Sales Only) $4.00.
Calculations with SYNTRONVOID have been made to simulate the operation of a 600 MW(e) CANDU reactor in some 2½ years. The results look reasonable as regards obtainable burnup and reactivity changes, whereas the power distribution is badly represented due to the quarter core symmetry used, and the lack of control system representation. It is demonstrated that minor refuelling errors, i.e., untimely refuelling of a few scattered channels, do not lead to unacceptable power distributions. It is also demonstrated that care has to be taken in planning the refuelling strategy in order to avoid accumulation of fresh and almost fresh channels. An island of 10 fresh channels, as occurred in the calculations knocked down the power to about ⅔. If it is felt that detailed 3D-calculations are desirable for guiding the operation it can be concluded that such calculations must be done on the full core. (auth)

2314 (ZJE-153) COOPERATION OF THE ŠKODA WORKS IN PHYSICAL STARTING OF THE A-1 NUCLEAR POWER PLANT. Zbytovsky, A. (Škoda, Pizen (Czechoslovakia)). 1974. 11p. Dep. NTIS (US Sales Only) $4.00.
One of the forms of long-term cooperation of the Škoda Works with Soviet organizations was its activities in the procurement of technological equipment for the first Czechoslovakian nuclear power plant set into operation towards the end of 1972. An important final stage in the construction was the preparation of the A-1 reactor for physical start-up and the realization of a program of verifying experiments of the physical start-up. This project was prepared by Škoda Works in cooperation with USSR, the Nuclear Research Institute at Řež, and the Nuclear Power Plant at Bohunice. (auth)

2315 CENTRAL TRITIUM MONITOR FOR CANDU NUCLEAR POWER STATIONS. Osborne, R. V. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 676-680(Feb 1975).
From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).
Tritiated water vapor in a sample air stream is collected in a water stream and measured in a scintillation flow counter. One mu Ci/m^3 can be detected with a response time constant of several minutes. The instrument, engineered for unattended operation, is insensitive to other airborne radionuclides, gamma radiation, and humidity variation. 4 references. (auth)

2316 CRITERIA FOR CALANDRIA DESIGN IN PRESSURE-TUBE REACTORS. Cornaggi, L.; Zampini, G. Trans. Amer. Nucl. Soc.; 20: 56-58(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2317 PERFORMANCE OF CANADIAN COMMERCIAL NUCLEAR UNITS AND HEAVY WATER PLANTS. Woodhead, L. W. Trans. Amer. Nucl. Soc.; 20: 160-162(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2318 STARTUP AND RESULTS FROM RECENT OPERATION OF THE BOHUNICE NUCLEAR POWER PLANT A-1, CZECHOSLOVAKIA. Kostovsky, K.; Keher, J.; Planovsky, L. Trans. Amer. Nucl. Soc.; 20: 162-165(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2319 TECHNICAL EVALUATION OF THE A-1 REACTOR ON THE BASIS OF OPERATIONAL EXPERIENCE. Filip, R.; Patrovsky, V. Trans. Amer. Nucl. Soc.; 20: 165-166(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2320 PERFORMANCE AND EVOLUTIONARY DEVELOPMENT OF CANDU FUEL. Bain, A. S.; Page, R. D.; Fanjoy, G. R.; Tarasuk, W. R.; Howieson, J. Trans. Amer. Nucl. Soc.; 20: 259-261(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2321 EVALUATION OF ATUCHA FUEL ELEMENT PERFORMANCE. Araoz, C.; Cirimello, R.; Sametband, M. J. Trans. Amer. Nucl. Soc.; 20: 261-263(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2322 ENDURANCE OF SGHWR FUEL ELEMENTS UNDER STEADY AND TRANSIENT CONDITIONS. Pickman, D. O.; Rose, K. M.; Robinson, J. A. Trans. Amer. Nucl. Soc.; 20: 263-265 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2323 FUEL MANAGEMENT IN CANDU REACTORS. Millar, C. H. Trans. Amer. Nucl. Soc.; 20: 350-351(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2324 PERFORMANCE AND RELIABILITY OF PRIMARY CIRCUIT COMPONENTS IN CANDU REACTORS. Ross-Ross, P. A.; Adams, E. J.; Dixon, D. F.; Metcalfe, R. Trans. Amer. Nucl. Soc.; 20: 577-578(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2325 CANADIAN PROGRAM TO INVESTIGATE VIBRATION AND FRETTING IN NUCLEAR FUEL ASSEMBLIES. Oldaker, I. E.; Lane, A. D.; Paidoussis, M. P.; Forrest, C. F. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Eng. J. (Montreal); 57: No. 7, 109-113(1974).

More precise knowledge of the hydraulic conditions that excite vibrations, and a better understanding of the detailed fretting process are needed to obtain an overall model describing vibration and fretting of fuel assemblies for present and future reactors. String motions in vertical reactors such as the Gentilly-1 BLW occur typically at frequencies of 40-60 Hz for fuel elements, and at 0.3-10 Hz for a string of attached bundles; individual horizontal bundles are thought to vibrate at frequencies of about 20-40 Hz. Methods of limiting and controlling these motions must be evaluated. (CA)

Power Reactors, Breeding

Refer also to abstracts 438, 1506, 2175, 2673, 2674, 2676, 2682, 2689, 2712, 2715, 2726–2730, 2746, 2750–2767, 2773, 2843, 2898, and 2899.

2326 (ANL-75-11) PARAMETRIC STUDY OF SODIUM AEROSOLS IN THE COVER-GAS SPACE OF SODIUM-COOLED REACTORS. Sheth, A. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 55p. Dep. NTIS $4.00.

A mathematical model has been developed to describe the behavior of sodium aerosols in the cover-gas space of a sodium-cooled reactor. A review of the literature was first made to examine methods of aerosol generation, mathematical expressions representing aerosol behavior, and pertinent experimental investigations of sodium aerosols. In the development of the model, some terms were derived from basic principles and other terms were estimated from available correlations. The model was simulated on a computer, and important parameters were studied to determine their effects on the overall behavior of sodium aerosols. The parameters studied were sodium pool temperature, source and initial size of particles, film thickness at the sodium pool/cover gas interface, wall plating parameters, cover-gas flow rate, and type of cover gas (argon and helium). The model satisfactorily describes the behavior of sodium aerosol in argon, but not in helium. Possible reasons are given for the failure of the model with helium, and further experimental work is recommended. The mathematical model, with appropriate modifications to describe the behavior of sodium aerosols in helium, would be very useful in designing traps to remove aerosols from the cover gas of sodium-cooled reactors. (auth)

2327 (ANL/EBR-090) LOADING DIAGRAMS OF EXPERIMENTAL SUBASSEMBLIES STARTING IRRADIATION IN EBR-II RUNS 63-76. Case, J. C.; Larson, W. J. (comp.). (Argonne National Lab., Ill. (USA)). Feb 1975. 111p. Dep. NTIS $8.75.

This report contains the loading diagrams for all experimental subassemblies as they were fabricated for irradiation starting in EBR-II runs 63 through 76. It supplements three similar reports: ANL/EBR-015, for runs 5 through 42; ANL/EBR-043, for runs 43 through 50; and ANL/EBR-074, for runs 51 through 62. Each diagram, with its accompanying table, gives the location, identification number, and content of each capsule (or element) in the subassembly. The arrow on each diagram shows the direction to the EBR-II core center at the time of the initial loading of the subassembly into the reactor grid. (Directions to the core center after any subsequent relocations are not shown.) Information with each diagram gives the type of hardware, orifice size, results of flow-testing of the fabricated assembly (where applicable), date and place of assembly, and date placed into the reactor. (auth)

2328 (ANL-RDP-37) REACTOR DEVELOPMENT PROGRAM, PROGRESS REPORT. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-Eng-38. vp. AT.

Progress is reported in the following areas: (1) EBR-2 operations and testing; (2) LMFBR design support; (3) instrumentation and control; (4) fuels and materials development; (5) reactor physics; (6) reactor safety; (7) environmental studies; and (8) GCFR studies. (JWR)

2329 (CONF-740964-) SPECIALISTS MEETING ON OPERATING EXPERIENCE AND DESIGN CRITERIA OF SODIUM VALVES, HANFORD ENGINEERING DEVELOPMENT LABORATORY, RICHLAND, WASHINGTON, SEPTEMBER 23–27, 1974. Summary Report. (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). 1974. 605p. Dep. NTIS $13.60.

Separate abstracts were prepared for 12 of the 14 papers included. The 2 remaining papers have previously appeared in NSA. (JWR)

For abstracts of individual papers see: 2330–2341.

2330 (CONF-740964-, pp 13-30) LARGE SODIUM VALVE DESIGN AND OPERATING EXPERIENCE. Vercasson, M.; Nedelec, J.; Abramson, R.; Elie, X. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

Valves for sodium pipes with rated diameters of 125 mm or larger are conventionally known as "large sodium valves". However, the specifications and qualification tests are the same for isolation valves of up to 300 mm in diameter as for small-diameter valves, except for prototypes of larger diameter models. Because of their limited number, no standardization currently exists for isolation valves above 300 mm or for flow control valves. Following a brief description of existing valves, this note examines some of the difficulties encountered in developing and operating these valves, and concludes with an outline of the current development program. (auth)

2331 (CONF-740964-, pp 31-45) SMALL SODIUM VALVE DESIGN AND OPERATING EXPERIENCE. Abramson, R. (CEN de Cadarache, St.-Paul-lez-Durance, France); Elie, X.; Vercasson, M.; Nedelec, J. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

Conventionally, valves for sodium pipes smaller than 125 mm in diameter are called "small sodium valves". However, this limit should rather be considered as the lower limit of "large sodium valves". In fact, both the largest sizes of small valves and the smallest of large valves can be found in the range of 125-300 mm in diameter. Thus what is said about small valves also applies, for a few valve types, above the 125 mm limit. Sodium valves are described here in a general manner, with no manufacturing details except when necessary for understanding valve behavior. Operating experience is pointed out wherever possible. Finally, some information is given about ongoing or proposed development plans. (auth)

2332 (CONF-740964-, pp 47-67) SODIUM VALVES FOR SODIUM AND ARGON CONTAINING SODIUM AEROSOLS DIAMETER LESS THAN OR EQUAL TO 300 MM. Specification Standardization Qualification. Elie, X. (CEN de Cadarache, St.-Paul-lez-Durance, France); Le Roux, G.; Vercasson, M. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

Specifications are presented for the design, fabrication, and testing of sodium valves. (JWR)

2333 (CONF-740964-, pp 69-84) SODIUM VALVE TEST FACILITY DESCRIPTION. Nedelec, J.; Vercasson, M.; Abramson, R.; Venobre, H. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

The three main plants for sodium valve testing are: (1) One "valve loop", operational, at the Centre des Renardieres (Electricite de France), for testing devices up to 500 mm in diameter; (2) One testing plant, under construction, at the Centre de Cadarache (Commissariat a l'Energie Atomique) including two test sections, one up to 100 mm and the other up to 300 mm in diameter; and (3) One "large valve" test facility, being studied at the Centre des Renardieres (EDF), designed for testing valves in the range of 700 to 1200 mm in diameter. Besides these three plants, some auxiliary facilities allow the adjustment of valve components. Finally, several water test facilities permit hydraulic testing, at Chatou and Gennevilliers (EDF) and at Nantes (Centre Technique des Industries Mecaniques). (auth)

2334 (CONF-740964-, pp 85-169) OPERATING EXPERIENCE AND DESIGN CRITERIA OF SODIUM VALVES. Markford, D. (INTERATOM, Bensberg, Ger.). 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

The information presented refers to sodium valve development for KNK and SNR-300 as well as for sodium test facilities on the INTERATOM site at Bensberg. Well in advance of KNK-I a number of sodium test facilities have been operated containing small and medium size valves of different design and manufacturer. The more stringent requirements for long range safe and reliable operation in KNK-I put forth a development program for the main primary and secondary circuit sodium valves. Operational experience gave rise to modification of the stem seal arrangement mainly, so KNK-II (which is the fast core for KNK reactor) will be run with modified sodium valves. Main pipe diameters in SNR-300 are in the range of 600 mm. Valve designs with rising shafts would require excessive space in the primary circuit cavities, therefore efforts have been directed towards introduction of different type valves. Due to the requirements of after-heat-removal a valve type with control capability had to be chosen. A special design of butterfly valves was selected for the primary and secondary circuits of SNR-300. The development and tests performed with this type of valve are described. In the field of small sodium valves, tests with a 50 mm diameter freeze-seal valve are reported, and the current status of bellows-seal-valves to be inserted into SNR-300 is discussed. (auth)

2335 (CONF-740964-, pp 171-253) REVIEW OF ITALIAN ACTIVITIES ON SODIUM VALVES. Amoia, M. (NUOVO PIGNONE, Bari, Italy); Avanzini, P. A.; Vignoli, G. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

A review on the production, testing, and operating experience of sodium valves in Italy is presented. (JWR)

2336 (CONF-740964-, pp 255-340) OPERATING EXPERIENCE AND DESIGN CRITERIA OF SODIUM VALVES: JAPAN. Imanaka, N. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Aoki, T.; Yamanari, K. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

In order to acquire necessary data to design an experimental fast breeder reactor JOYO which is now under construction in Japan by Power Reactor and Nuclear Fuel Development Corporation (PNC), various sodium test loops were set up at O-arai Engineering Center where various tests were carried out. The operation of these test loops will continue as before and in addition the construction of some new test facilities is under way, to do the necessary testing for the development of a prototype reactor MONJU. The operating experience of those test loops which include sodium test facilities and some of the results obtained from testing are discussed. (auth)

2337 (CONF-740964-, pp 341-362) OPERATING EXPERIENCE WITH SODIUM VALVES IN THE TNO-SODIUM TEST FACILITIES. van Gasselt, M. L. G. (Central Technical Inst., TNO, Apeldoorn, Netherlands). 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

The development of sodium components for the SNR-300 in Holland has reached the stage where full scale testing in sodium has almost been finished and construction is at its height. It is against this background that a review is given of the weaknesses in one area or the other of the commercially available types of sodium valves used in TNO's smaller test facilities at Apeldoorn and TNO's 50 MW sodium components test facility at Hengelo. (auth)

2338 (CONF-740964-, pp 363-412) OPERATING EXPERIENCE AND DESIGN CRITERIA OF SODIUM VALVES. Delves, P. H. (United Kingdom Atomic Energy Authority, Risley, Eng.); Seed, G.; Orszak, P. 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

The development of valves for use in liquid metal systems was initiated about 18 years ago, when the UK embarked on its fast reactor programme. Initially the requirement was for a hand operated valve of about 1 in. nominal bore for rig applications and since none of the standard valves commercially available at that time were suited to this duty the development of a special valve was initiated by the UKAEA. With the initiation of construction of the Prototype Fast Reactor at Dounreay there arose a new requirement for a large number of small valves, covering the size range ¼ in. to 6 in. nb., capable of automatic or manual operation, and manufactured to stringent quality standards appropriate to reactor duty. A special range of valves were developed for this duty by the English Electric Company. Applications have also been found for these valves in test rigs and non-nuclear process plant which involves the handling of liquid alkali metals. The only other requirements for valves of larger diameter than those mentioned above have also arisen from PFR. Large butterfly valves are fitted to the main secondary pipework in order to isolate the steam generators from the reactor plant in the event of a major sodium/water reaction. Stop and non-return valves are fitted to the discharge pipes of each of the main primary pumps. Large sleeve type valves are fitted to the primary side of the Intermediate Heat Exchangers. Satisfactory experience with the development of these valves allows future requirements for large valves to be tackled with confidence. (auth)

2339 (CONF-740964-, pp 413-462) LARGE SODIUM VALVE DESIGN AND OPERATING EXPERIENCE IN THE UNITED STATES. Nulton, J. D. (Atomic Energy Commission, Washington, DC). 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

Large sodium valve technology in the United States from the late 1950s to the present is described. Brief mention is made of early valve experience in facilities such as SRE, Hallam, SCTI, LCTL, and FERMI. Emphasis is placed on recent valve development work performed in support of the LMFBR and related test facilities. This work includes valve designs for the FFTF, SPTF, and valve development for possible use in the CRBR, Demonstration Plant and subsequent LMFBR facilities. (auth)

2340 (CONF-740964-, pp 463-527) SMALL SODIUM VALVE DESIGN AND OPERATING EXPERIENCE. McGough, C. B. (Hanford Engineering Development Lab., Richland, WA). 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23-27, 1974. Summary report.

The United States Liquid Metal Fast Breeder Reactor program (LMFBR) includes an extensive program devoted to the development of small sodium valves. This program is now focused on the development and production of valves for the Fast Flux Test Facility (FFTF) now under construction near Richland, Washington. Other AEC support facilities, such as various test loops located at the Liquid Metal Engineering Center (LMEC), Los Angeles, California, and at the Hanford Engineering Development Laboratory (HEDL), Richland, Washington, also have significant requirements for small sodium valves, and valves similar in design to the FFTF valves are being supplied to these AEC laboratories for use in their critical test installations. A principal motivation for these valve programs, beyond the immediate need to provide high-reliability valves for FFTF and the support facilities, is the necessity to develop small valve technology for the Clinch River Breeder Reactor Plant (CRBRP). FFTF small sodium valve design and development experience will be directly applied to the CRBRP program. Various test programs have been, and are being, conducted to verify the performance and integrity of the FFTF valves, and to uncover any potential problems so that they can be corrected before the valves are placed in service in FFTF. The principal small sodium valve designs being utilized in current U. S. programs, the test and operational experience obtained to date on them, problems uncovered, and future development and testing efforts being planned are reviewed. The standards and requirements to which the valves are being designed and fabricated, the valve designs in current use, valve operators, test and operating experience, and future valve development plans are summarized. (auth)

2341 (CONF-740964-, pp 529-547) SODIUM VALVE TEST RESULTS AND FACILITY DESCRIPTIONS. Horning, J. F. (Atomics International Div., Canoga Park, CA). 1974.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

In specialists meeting on operating experience and design criteria of sodium valves, Hanford Engineering Development Laboratory, Richland, Washington, September 23–27, 1974. Summary report.

The test program for qualifying sodium valves for LMFBR service is described and some test results are reviewed. The test facilities are also described. (JWR)

2342 (COO-2245-12) ANALYSIS OF MIXING DATA RELEVANT TO WIRE-WRAPPED FUEL ASSEMBLY THERMAL-HYDRAULIC DESIGN. Khan, E. U.; Rohsenow, W. M.; Sonin, A. A.; Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1974. Contract AT(11-1)-2245. 167p. AT.

Analysis of recent experimental data is presented using the ENERGY code. A comparison of the accuracy of three types of experiments is also presented along with a discussion of uncertainties in utilizing this data for various code calibration purposes. The existence of internal swirl is discussed. The two empirical coefficients in ENERGY are determined from the data within a certain range of accuracy. This range is dictated to a large extent by the accuracy of the experiments and to a smaller extent by the ability of the code to utilize all sets of data in each experiment. The effect of geometry and bundle size on mixing and swirl flow is discussed. A realistic estimate of the degree of accuracy within which we can predict temperature distribution within the bundle and along the duct of a 217-pin wire wrapped fuel assembly of an LMFBR is presented. Gaps in data which need to be filled in to enhance our confidence in predicting coolant temperature distributions in a 217-pin LMFBR fuel bundle are given. A brief description of two experiments that would fill these data gaps is presented. 30 references. (auth)

2343 (COO-2245-14) COOLANT MIXING IN LMFBR ROD BUNDLES AND OUTLET PLENUM MIXING TRANSIENTS. Quarterly Progress Report, September 1, 1974–November 30, 1974. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1974. Contract AT(11-1)-2245. 41p. Dep. NTIS $5.25.

Information is presented concerning bundle geometry (wrapped and bare rods), subchannel geometry (bare rods), and LMFBR outlet plenum flow mixing. (DCC)

2344 (ERDA-tr-19) OPTIMIZATION OF DOUBLING TIME AND THE FUEL COMPONENT OF DESIGN COSTS FOR FAST REACTORS BY PARTIAL FUEL RELOADING. Grachev, E. A.; Deynega, N. L.; Afanas'eva, L. D. (USERDA, Washington, D. C.). 1974. Translated by W. J. Grimes (W. J. Grimes and Co.), from NIIAR-P-229. 16p. Dep. NTIS $4.00.

Various methods of reloading spent fuel are considered, and their advantages and disadvantages are discussed. A method is proposed for designing reloading modes that can serve as the basis for deriving the results of optimization calculations for the doubling time (T_2) and the fuel component (FC/sub c1/). Conclusions are drawn regarding the advantage of using partial reloading, and optimum systems are selected. Calculations are made for reactors that are governed by the composition and enrichment of the fuel. These studies may be useful for the development of large fast reactors. 5 references. (auth)

2345 (EURFNR-1191) DESIGN, IRRADIATION, AND POST-IRRADIATION EXAMINATION OF UO_2/PuO_2 FUEL PIN EXPERIMENTS IN FR-2 TEST GROUP 4b. Weimar, P.; Dippel, T.; Freund, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Mar 1974. Translation of KFK-1952. 287p. Dep. NTIS $10.60.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The irradiation of 35 fuel pin samples with UO_2–PuO_2 fuel of the experiment called "Capsule Group No. 4b", irradiated in the thermal flux of the Karlsruhe research reactor FR 2, represents a further testing of the SNR basic fuel pin concept. The irradiation has been carried out in 11 Na/PbBi double-capsules, where 3 – 4 samples are stacked one above the other. The fuel column of 80 mm length consists of pellets with a Pu-content of 20 w/o. Two different fuel densities of 84 and 90 percent T. D., corresponding to smeared densities of 80 resp. 85 percent T. D., have been realized. The austenitic stainless steel claddings have an outer diameter of 6.0 mm with a wall thickness of 0.38 mm. The total length of the fuel pin is 172 mm. The capsules have been irradiated at normal fuel element or isotope canal positions. At linear rod powers up to 620 W/cm and clad surface temperatures of max. 770° the burnup lies between 10 and 120 MWd/kg Metal. The samples have been irradiated between 46.2 and 517.5 days full power (44 MW) equivalent. All fuel pins are intact. In the present documentation a compilation of design, specification and fabrication as well as a detailed description of irradiation and post irradiation examination results are given. (auth)

2346 (EURFNR-1194) MEASUREMENT AND CALCULATION OF NEUTRON SPECTRA NEAR A SODIUM/IRON INTERFACE. Kappler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1974. Translation of KFK-1959. 92p. Dep. NTIS $7.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The work is devoted to the problem of the strongly spatially dependent neutron spectra in a sodium/iron interface. These materials are employed in fast breeder reactors and are therefore of interest. Also, the change in a spectrum near an interface can be investigated most simply by observing the flux depression caused by a large and isolated resonance. These properties are found in the 2,85 keV sodium resonance. An interface of metallic sodium and steel in plate geometry had to be set up for the experimental determination of the neutron spectra. The sodium was poured into stainless steel tanks. The spatially dependent spectra were measured by the time-of-flight method in the SUAK fast subcritical assembly at Karlsruhe, with a flight path of 52 m. An extensive program was necessary for measuring the neutron spectrum in the sodium/iron interface as a function of place and energy for six locations. In order to obtain the spectrum as a function of energy at each location, eight measurements had to be carried out in each case. To insure adequate statistical accuracy, two such individual measurements were performed each day. These were a measurement with a free beam path and a transmission measurement for determining the background curve. The apparatus must be stable over the entire measuring period so as to insure that the spectra can be given as a function of place and energy. The aim of this work was to compare the measured and calculated spectra and to determine the amount of calculation necessary to achieve satisfactory agreement. In order to insure the most accurate description possible of the resonances in sodium and iron, the energy region must be divided up into narrow intervals (groups). Since the storage capacity of the available computers is limited, a calculation in a large number of energy groups can only be performed in a simple geometric representation with one single spatial coordinate. It was demonstrated that this is not sufficient for an interpretation of the experimental results. A more accurate geometric representation can only be done by reducing the number of energy groups which can be employed. These are selected so that the resonances can nonetheless still be described satisfactorily. (auth)

2347 (KFK-1274/2) 2ND QUARTERLY REPORT 1974. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Oct 1974. vp. (In German). (EUR-4979-d). INIS.

This report covers investigations performed by departments of the GfK in Karlsruhe, the subjects being: fuel pin development,

materials testing and development, corrosion tests and coolant analysis, fuel cycle, physical experiments, safety and instrumentation; it also deals with investigations into technological problems. (GE)

2348 (ORNL-TM-4804) METHOD FOR CALCULATING THE STEADY-STATE DISTRIBUTION OF TRITIUM IN A MOLTEN-SALT BREEDER REACTOR PLANT. Briggs, R. B.; Nestor, C. W. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 82p. Dep. NTIS $5.45.

Tritium is produced in molten salt reactors primarily by fissioning of uranium and absorption of neutrons by the constituents of the fuel carrier salt. At the operating temperature of a large power reactor, tritium is expected to diffuse from the primary system through pipe and vessel walls to the surroundings and through heat exchanger tubes into the secondary system which contains a coolant salt. Some tritium will pass from the secondary system into the steam power system. This report describes a method for calculating the steady state distribution of tritium in a molten salt reactor plant and a computer program for making the calculations. The method takes into account the effects of various processes for removing tritium, the addition of hydrogen or hydrogenous compounds to the primary and secondary systems, and the chemistry of uranium in the fuel salt. Sample calculations indicate that 30 percent or more of the tritium might reach the steam system in a large power reactor unless special measures are taken to confine the tritium. (auth)

2349 (RSA-TM-2) PRELIMINARY PHYSICS CALCULATIONS FOR THE CLINCH RIVER BREEDER REACTOR. Kalimullah. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-Eng-38. 40p. Dep. NTIS $5.00.

Calculations of sodium void, fuel, and clad worths, power distribution, and control rod worths have been carried out for an R-Z model of the CRBR, using diffusion theory and first-order perturbation theory for material worths. The power distribution and control rod worths have also been calculated in two-dimensional triangular mesh geometry. The present results are preliminary because of inaccuracy of the reactor model and the cross sections used, but the final results are not expected to be greatly different. (auth)

2350 MATERIALS CONCERNS FOR THE INTERMEDIATE HEAT TRANSPORT SYSTEM OF THE CRBRP. Licina, G. J.; Sandusky, D. W. Trans. Amer. Nucl. Soc.; 20: 82-86(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2351 STEAM GENERATOR MATERIAL FOR SODIUM-COOLED FAST BREEDER REACTORS: RESULTS AND FUTURE PROSPECTS. Berge; Donati; St. Paul; Valibus; Champeix; Coriou; Dixmier; Petrequin; Sebilleau; Weisz. Trans. Amer. Nucl. Soc.; 20: 86-89(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2352 RESULTS ON THE EXPERIENCE GAINED ON VESSEL MATERIALS FOR PHENIX: FUTURE PROSPECTS. Berge; Donati; Valibus; Petrequin; Sebilleau; Weisz. Trans. Amer. Nucl. Soc.; 20: 89-94(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2353 GAS-COOLED BREEDER REACTOR, A CONCEPT BASED ON MATURE TECHNOLOGY. Chermanne, J.; Van Asbroeck, P.; Sacriste, C. Trans. Amer. Nucl. Soc.; 20: 125-127 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2354 PROGRESS TOWARD A GAS-COOLED FAST BREEDER REACTOR DEMONSTRATION PLANT. Simon, R. H.; Meyer, L.; Guyker, W. C. Trans. Amer. Nucl. Soc.; 20: 127-129(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2355 CREYS-MALVILLE PLANT: OPTIONS AND DESCRIPTION. Saitcevsky, B.; Casini, R.; Robert E.; Janberg, K. G.; Megy, J.; Creete, J. P.; Granito, F.; Leduc, J. Trans. Amer. Nucl. Soc.; 20: 130-131(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2356 PROGRAM OF THE SUPER-PHENIX SODIUM EXPERIMENTS. Sauvage, M.; Benoist, E.; Chouard, P.; Jacquelin, R.; Martin, J. P.; Lion, A. Trans. Amer. Nucl. Soc.; 20: 131-132 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2357 INTERMEDIATE-POWER FAST BREEDER PLANTS. Aubert, R.; Boulinier, C.; Crette, J. P.; Gauzit. Trans. Amer. Nucl. Soc.; 20: 132-134(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2358 DESIGN OF THE CORE AND SUBASSEMBLIES OF A LIQUID-METAL FAST BREEDER REACTOR. Chaumont, M. M.; Clauzon, P.; Delpeyroux; Estavoyer; Ginier; Marmonier; Mougniot. Trans. Amer. Nucl. Soc.; 20: 134-135(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2359 DIGITAL SIMULATION OF THE DYNAMIC BEHAVIOR OF SODIUM-COOLED FAST REACTOR POWER PLANTS. Ballay, R.; Hery, M.; Perrin, M. Trans. Amer. Nucl. Soc.; 20: 135-137 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2360 ON THE THERMAL DESIGN OF STEAM GENERATORS FOR LMFBRs. Campolunghi, F.; Cumo, M.; Ferrari, G. Trans. Amer. Nucl. Soc.; 20: 137-139(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2361 INTERMEDIATE AND STEAM GENERATOR SYSTEMS OF THE CLINCH RIVER PLANT. Skavdahl, R. E.; Tippets, F. E.; Billuris, G.; Hikido, K. Trans. Amer. Nucl. Soc.; 20: 139-141 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2362 SYNTHESIS OF SCALE-MODEL STEAM GENERATOR TESTS PROPOSED FOR THE SUPER-PHENIX NUCLEAR POWER PLANT. Fontaine, J. P.; Llory, M.; Masse, J.; Quinet, J. L. Trans. Amer. Nucl. Soc.; 20: 141-144(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2363 PROBLEMS SPECIFIC TO THE PIPING OF SODIUM-COOLED FAST BREEDER REACTORS. Vrillon, B.; Montfort, C.; Befre, J.; Schaller, K. Trans. Amer. Nucl. Soc.; 20: 144-146 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2364 PHENIX AFTER ONE YEAR IN OPERATION. Conte, F. Trans. Amer. Nucl. Soc.; 20: 166(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2365 IN-SERVICE INSPECTION OF RAPSODIE'S SAFETY CONTAINMENT. Tomachevsky, E. G. Trans. Amer. Nucl. Soc.; 20: 176-177(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2366 TESTING OF A BAYONET-TYPE INTEGRATED STEAM GENERATOR SYSTEM FOR SODIUM-COOLED BREEDERS. Buescher, E.; Haubold, W.; Jansing, W.; Vinzens, K. Trans. Amer. Nucl. Soc.; 20: 206-209(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2367 TESTS CARRIED OUT FOR SNR-300 HANDLING AND THE INFLUENCE OF TEST RESULTS IN VIEW OF HANDLING EQUIPMENT DESIGN. Babilas, C.; Hoeft, E.; Kenkmann, W.; Kirchner, G.; Menck, J. Trans. Amer. Nucl. Soc.; 20: 209-211 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2368 MATERIAL PROBLEMS IN OXIDE FUEL PINS FOR FAST BREEDER REACTORS. Dienst, W.; Ehrlich, K. Trans. Amer. Nucl. Soc.; 20: 283-284(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2369 MAIN PROBLEMS RAISED BY THE IN-PILE BEHAVIOR OF MIXED OXIDE. Mikailoff, H. Trans. Amer. Nucl. Soc.; 20: 285-286(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2370 INNER CLADDING ATTACK IN MIXED-OXIDE FUEL PINS. Coquerelle, M.; Goetzmann, O.; Pickering, S. Trans. Amer. Nucl. Soc.; 20: 287-289(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2371 IRRADIATION OF VENTED FUEL ELEMENTS FOR FAST REACTORS. Cecchi, P. F.; Perrin, J.; Chenebault, P.; Kurka, G. Trans. Amer. Nucl. Soc.; 20: 289-291(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2372 BORON CARBIDE PERFORMANCE IN FAST REACTORS. Sheely, W. F.; Dahl, R. E.; Bennett, J. W. Trans. Amer. Nucl. Soc.; 20: 291-293(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2373 STUDY OF ADVANCED FUELS IN HIGHLY RATED He-BONDED PINS. Benedict, U.; Blank, H.; Bradbury, M.; Caligara, F.; Coquerelle, M.; Gabolde, J.; Giacchetti, G.; Mandler, R.; Matzke, H.; Richter, K.; Ronchi, C.; Sari, C. Trans. Amer. Nucl. Soc.; 20: 293-295(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2374 CARBIDE FUEL ELEMENT FOR FAST REACTORS: RESEARCH AND DEVELOPMENT PROGRAM. Lallement, R.; Mikailoff, H.; Ravier, J. Trans. Amer. Nucl. Soc.; 20: 296-298(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2375 MIXED-CARBIDE FUEL PROGRAM AT EIR. Stratton, R. W.; Bischoff, K. Trans. Amer. Nucl. Soc.; 20: 298-300(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2376 GENERAL CHARACTERISTICS OF FAST REACTOR FUEL PINS. Kummerer, K. Trans. Amer. Nucl. Soc.; 20: 301-304(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2377 DEVELOPMENT OF HONEYCOMB SPACER GRIDS FOR THE SNR 300 FAST REACTOR. Dewandeleer, J.; Grisel, J.; Wenk, K. H. Trans. Amer. Nucl. Soc.; 20: 304-305(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2378 DESIGN IMPLICATIONS OF MATERIAL PROPERTIES ON LMFBR FUEL ELEMENTS. Capart, G.; Dietz, W.; Hoechel, J.; Jonckheere, E.; Mayer, H.; Stevens, L. Trans. Amer. Nucl. Soc.; 20: 305-308(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2379 CHOICE OF THE PHENIX FUEL ELEMENT CHARACTERISTICS: FIRST RESULTS OF THEIR IN-PILE BEHAVIOR. Leclere, J.; Marcon, J. P. Trans. Amer. Nucl. Soc.; 20: 308 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2380 SUPER-PHENIX FUEL ELEMENT DESIGN. Leclere, J.; Ollier, H.; Rousseau, J.; Boyer, P. Trans. Amer. Nucl. Soc.; 20: 308-311(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2381 EVOLUTION OF FUEL DESIGNS FOR SODIUM-COOLED FAST REACTORS. Bishop, J. F. W.; Holmes, J. A. G. Trans. Amer. Nucl. Soc.; 20: 311-312(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2382 FFTF FUEL PIN DESIGN BASES AND PERFORMANCE. Cox, C. M.; Hanson, J. E.; Roake, W. E.; Slember, R. J.; Weber, C. E.; Millunzi, A. C. Trans. Amer. Nucl. Soc.; 20: 313-315(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2383 HIGH BURNUP PERFORMANCE OF LMFBR FUEL RODS: RECENT GE EXPERIENCE. Hilbert, R. F.; Aitken, E. A.; Pluta, P. R. Trans. Amer. Nucl. Soc.; 20: 315-318(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2384 IRRADIATION BEHAVIOR OF THE MIXED-OXIDE DRIVER FUEL ELEMENTS OF RAPSODIE-FORTISSIMO. Anselin, F.; Allain, C.; Mercier, C.; Clottes, G. Trans. Amer. Nucl. Soc.; 20: 318-320(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2385 IRRADIATION BEHAVIOR OF THE MIXED-OXIDE DRIVER FUEL ELEMENTS OF RAPSODIE 24 MW. Anselin, F.; Mercier, C.; Clottes, G. Trans. Amer. Nucl. Soc.; 20: 320-323(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2386 HIGH BURNUP MIXED-OXIDE FUEL IRRADIATION EXPERIMENTS IN RAPSODIE. Anselin, F.; Carteret, Y.; Battaler, S.; Chalony, A. Trans. Amer. Nucl. Soc.; 20: 323-326(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2387 FUEL MANAGEMENT CODES FOR FAST REACTORS. Sicard, B.; Coulon, P.; Mougniot, J. C.; Penet, M.; Pontier, M.; Skok, J. Trans. Amer. Nucl. Soc.; 20: 347-348(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2388 BREEDING GAINS OF FAST REACTORS FUELED WITH PuO_2-UO_2 OXIDES AND COOLED WITH SODIUM. Mougnoit, J. C.; Barre, J. Y.; Clauzon, P.; Giacometti, C.; Ravier, J.; Sicad, B. Trans. Amer. Nucl. Soc.; 20: 348-349(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2389 CEA BURNUP PHYSICS STUDIES FOR FAST-NEUTRON POWER REACTORS. Barre, J. Y.; Bouchard, J. Trans. Amer. Nucl. Soc.; 20: 349-350(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2390 USE OF COMPENSATION ASSEMBLIES IN THE FIRST CORE OF SNR-300. Billaux, M.; de Wouters, R.; Pilate, S.; Vandenberg, C.; Spenke, H.; Stojadinovic, A.; Wehmann, U. Trans. Amer. Nucl. Soc.; 20: 384-385(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2391 STUDY OF POSSIBLE FAST BREEDER REACTOR PENETRATION STRATEGIES IN EUROPE. Effantin, M.; Israel, S.; Montfort, J.; Pasquet, J. P. Trans. Amer. Nucl. Soc.; 20: 398-401(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2392 SODIUM VALVE OPERATING EXPERIENCE: STANDARDIZATION. Elie; Abramson; Morier; Vercasson. Trans. Amer. Nucl. Soc.; 20: 570-572(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2393 TESTING PLUTONIUM FUEL ASSEMBLY PRODUCTION FOR FAST-NEUTRON REACTORS. Nougues, B.; Benhamou, A.; Bertothy, G.; Lepetit, H. Trans. Amer. Nucl. Soc.; 20: 574-576(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2394 PLUTONIUM FUEL DEVELOPMENT AND PRODUCTION. Filpot, A. J.; Leblanc, J. M.; Lafontaine, I. Trans. Amer. Nucl. Soc.; 20: 596-598(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2395 FUEL ELEMENT FABRICATION PLANT FOR SUPER-PHENIX. Vialard, J. L.; Heyraud, J.; Pajot, J. Trans. Amer. Nucl. Soc.; 20: 598-602(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2396 NEUTRON-RADIOGRAPHY INSTALLATION FOR THE CONTROL OF PLUTONIUM-ENRICHED FUEL PINS. Deprez, G.; Mostin, N. Trans. Amer. Nucl. Soc.; 20: 602-603 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2397 FABRICATION AND INSPECTION OF STAINLESS-STEEL-CLAD TUBES FOR FAST REACTORS. Spriet, B.; Jacson, M. Trans. Amer. Nucl. Soc.; 20: 614-617(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2398 HIGH-TEMPERATURE GAS-COOLED BREEDER REACTOR (HTBR). Yellowlees, J. M.; Kraehe, A.; Oppenheim, C.; van Steenberghe, T.; Vieider, G. Trans. Amer. Nucl. Soc.; 20: 704-707(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2399 DESIGN CONCEPT OF EXPERIMENTAL MULTI-PURPOSE VHTR. Ishikawa, H.; Shimokawa, J.; Yasuno, T.; Yasukawa, S. Trans. Amer. Nucl. Soc.; 20: 707-711(Apr 1975)
From European nuclear conference; Paris, France (21 Apr 1975).

2400 FAST REACTORS: THERMAL CALCULATIONS OF ANNULUS APPLICATION TO PHENIX. Kung, J. P.; Gama, J. M. Trans. Amer. Nucl. Soc.; 20: 749-752(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2401 TEMPERATURES OF STRUCTURES IMMERSED IN THE PHENIX REACTOR. Daubert, O.; Gama, J. M.; Malherbe, J. F. Trans. Amer. Nucl. Soc.; 20: 752-754(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2402 THERMAL-HYDRAULIC STUDIES APPLIED TO SODIUM BREEDERS. Daubert, A.; Gollion, H. J.; Martin, R.; Sauvage, M. Trans. Amer. Nucl. Soc.; 20: 754-756(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2403 HYDRAULIC INVESTIGATIONS WITH A COMPLETE SEVEN-SUBASSEMBLY ARRAY UNDER SODIUM. Hess, B.; Ruppert, E.; Stehle, H.; Vinzens, K. Trans. Amer. Nucl. Soc.; 20: 764-768(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2404 EXPERIENCE IN COMMISSIONING WORKS AND ENERGETIC START-UP OF THE BN-350 REACTOR. Leipunskii, A. I.; Mitenkov, F. M.; Orlov, V. V. (State Committee for the Use of Atomic Energy, Moscow). Kernenergie; 17: No. 12, 367-372(Dec 1974). (In German).
The energetic start-up of the first industrial nuclear power plant provided with a fast reactor of BN-350 type was at Shevchenko on July 16, 1973. After achieving its nominal power of N_{th} = 1000 MW the reactor will yield an electrical power of 150 MW and will produce 120000 m^3 of fresh water per day. The main stages of its erection and start-up are described. The experience gathered during coolant preparation and start-up works of the coolant loops is presented. Moreover, the results of studies of the dynamical characteristics and energetic start-up of the nuclear power plant are discussed. (auth)

2405 ESCAPE OF GASEOUS FISSION PRODUCTS FROM DEFECTIVE BOR-60 FUEL ELEMENTS. Krasnoyarov, N. V.; Konyashov, V. V.; Polyakov, V. I.; Chechetkin, Yu. V. At. Energ. (USSR); 38: No. 2, 67-71(Feb 1975). (In Russian).
An analysis of ^{133}Xe and ^{135}Xe radioactivity measurements of cavity gas in reactor BOR-60 is given. It is shown that the formation of defects in fuel element cladding is accompanied by the escape of radioactive gaseous fission products equal to a fraction of the yield from the fuel and amounts to (5.3 ± 1.0)% for ^{133}Xe. The escape of other radioactive inert gases is roughly proportional to the one-half power of their half-lives, which confirms that the nature of the release is diffusional. Owing to the small release of radioactive gases when defects are formed and the considerably smaller release during further operation, the number of defective fuel elements in the core is not limited by the radioactivity in the gas system. The results are compared with data from the system of defective element detection based on delayed neutrons. (auth)

2406 FUEL ELEMENTS AND ASSEMBLIES FOR GAS-COOLED BREEDER REACTORS. Gauthron, M. (to CEA). French Patent 2,205,711/A/. 8 Nov 1972. 6p. (In French).
The invention relates to fuel elements adapted to be used in gas cooled breeder reactors, and also to assemblies containing the fuel elements. Each fuel-element adapted to be placed in the core of a gas-cooled breeder reactor is characterized in that it is in the form of balls of a diameter of from 10 to 30mm formed of uranium-plutonium mixed oxide or carbide dispersed in a matrix of refractory or of ceramics. (FR)

2407 FUEL ELEMENTS AND FUEL ASSEMBLIES FOR BREEDER REACTORS. Gauthron, M. (to CEA). French Patent 2,205,712/A/. 8 Nov 1972. 7p. (In French).
The invention relates to porous fuel elements and to assemblies of such fuel elements for the equipment of gas cooled breeder reactors. Use is made of a fuel element in the form of elementary particles of a diameter of from 0.2 to 1mm, made of uranium-plutonium mixed oxide or carbide dispersed in a matrix of refractory metal or of ceramics as regards the fissile portion and of uranium oxide or carbide as regards the fertile portion. These particles are coated with pyrocarbon and bound by a minimal amount of carbonated compound so as to form a monolithic structure of the desired shape. (FR)

2408 NUCLEAR FUEL ASSEMBLY IN PARTICULAR FOR FAST NEUTRON REACTORS. Marmonier, P.; Mesnage, B. (to CEA). French Patent 2,197,208/E/. 22 Aug 1972. 8p. (In French).
Improvements in nuclear fuel assemblies such as claimed in the main patent are described. These improvements consist in linking the envelope segments of each assembly by means of a ball-and-socket coupling or a universal joint, or a resilient cross piece. These improvements make it easier to manufacture the envelope by permitting the segments thereof to move angularly as desired. (FR)

2409 A SAFETY DEVICE FOR RESTRICTING THE PRESSURE OF A FLUID. Nedelec, J. (Electricite de France, 75 - Paris); Buffet, P.; Michel, A. (Societe Europeenne de Propulsion (SEP), 92 - Puteaux (France)). (to Electricite de France). French Patent 2,192,719/D/. 11 Jul 1972. 8p. (In French).
This device comprises a hollow member open at both ends, a preformed diaphragm adapted to obturate one of these ends and the convex side of which is turned towards the member inside, an axial knife integral with a structure mounted at the other end of the hollow member, the knife tip being spaced from the diaphragm-convex side by an adjustable distance so that a given pressure applied against the diaphragm concave side brings the diaphragm into contact with the knife tip, thus bearing the diaphragm, ducts provided in the modular-member lateral wall for the tight passage of fluids and/or of devices adapted to feel the diaphragm, means for assembling the diaphragm and the knife at each end, and sealing means. The invention can be applied to the safety devices for sodium-cooled fast-neutron reactors. (FR)

Research, Test, and Experimental Reactors

Refer also to abstracts 988, 2328, 2334, 2340, 2868, and 2915.

2410 (AED-CONF-74-497-002) CHEMISTRY IN SODIUM-COOLED NUCLEAR POWER PLANTS. Experience Gained With the Compact Sodium-Cooled Nuclear Reactor KNK. Haubold, W.; Stade, K. C.; Stamm, H. H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1974. 25p. (In German). INIS.
From VGB conference "chemistry in the power plant 1974"; VGB feed water conference 1974; Essen, F. R. Germany (29 Oct 1974).
Sodium as heat exchanger in nuclear power plants, plant systems of sodium-cooled nuclear power plants, the behavior of structure and cladding materials in sodium, impurities of sodium and of the protective gas, the control of sodium and protective gas purity and operational experience on chemical problems at the KNK plant are dealt with. (GE)

2411 (BNWL-1213) COMPUTERIZED PREVENTIVE AND CORRECTIVE MAINTENANCE SYSTEM FOR FFTF FUELS DEMONSTRATION FACILITY. Jackson, M. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 19 Nov 1969. Contract AT(45-1)-1830. 28p. Dep. NTIS $4.50.
The Preventive Maintenance Management Plan described pertains to the FFTF Fuels Department operations in the Plutonium Fuels Laboratory–308 Building. This is one component of an overall Preventive Maintenance Program which includes other facilities at Battelle-Northwest. (auth)

2412 (GSF-P-65) ROUTINE DETERMINATION OF NEUTRON FLUX DENSITIES IN THE CORE AND IN IRRADIATION CHANNELS OF THE FRN BY MEANS OF ACTIVATION PROBES. Grundler, W.; Jentzsch, U.; Stark, W. (Gesellschaft fuer Strahlen-und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Physikalisch-Technische Abt.). May 1974. 28p. (In German). INIS.
Measuring probe carriers for various standardized neutron flux measurements in the core and in irradiation and experimental channels of the FRN are outlined. Set-up and calibration of two firmly installed scintillation spectrometer measuring units are described which serve to determine the activity of γ-emitted radionuclides. In order to determine neutron fields, mathematical evaluation methods and correction parameter determinations are pointed out, and the physical data used are shown in tables corresponding to the latest standardized values. (GE)

2413 (HEDL-TME-71-100) SPECIFICATIONS AND INFORMATION PERTAINING TO A TECHNICAL REPORT DESCRIBING A SYSTEM AND/OR VERIFYING FAULTY SUBASSEMBLIES CONTAINING FUEL PIN CLADDING FAILURES IN THE FAST FLUX TEST FACILITY (FFTF). Cash, R. J.; Holt, F. E. (Han-

ford Engineering Development Lab., Richland, Wash. (USA)). 22 Jul 1971. Contract AT(45-1)-2170. 116p. AT.

The FFM system on the FFTF will monitor the fuel subassemblies for purposes of detecting, characterizing, locating and verifying fuel pin cladding failures. This "Specifications and Information" document is concerned with the location and verification of one or more of the 73 subassemblies each of which may contain one or more fuel pins whose cladding has failed. Devices for the detection and annunciation of fuel pin failures are considered to be developed to a state to provide adequate response for the FFTF. Therefore, detection devices are excluded from consideration unless detection is an inherent capability of the device or scheme proposed for location and verification of FFTF failed fuel pins. (auth)

2414 (HEDL-TME-75-17) PARAMETER VARIATIONS FOR IMPROVED FISSION COUNTER PERFORMANCE. Philipp, L. D.; Hoitink, N. C. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2170. 39p. Dep. NTIS $4.00.

Neutron flux instrumentation requirements for the Fast Flux Test Facility (FFTF), being constructed by the Westinghouse Hanford Company for the U.S. Atomic Energy Commission, impose operating conditions on neutron detectors used in vessel. To meet the objectives of high sensitivity [0.5 count/sec per nv] in a gamma flux of 10^6 R/hr, systematic tests were completed on commercially available fission counters. Further testing, with the detector that performed the best at high gamma dose rates, showed Ar-7 per cent N_2 to be a suitable detector fill gas when compared to the other argon-nitrogen mixtures evaluated. Tests were conducted with a 0.040 inch plate spacing detector. The tests were performed using the same techniques used with the first two detectors. Tests results from the three detectors (the 0.125, 0.080 and 0.040 inch plate spacing) have been assembled. A review of the previous data is presented and compared with the results from the 0.040 inch plate spacing detector. Conclusions concerning the effects of various parameters upon performance can be made with a model which has been developed. Selected data from other detector tests are also presented for comparison. 7 references. (auth)

2415 (JUL-1084-BB) PREDICTION OF FAST NEUTRON FLUX DENSITY IN FUEL CHANNELS OF THE RESEARCH REACTOR FRJ-2. Weise, L. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Zentralabteilung Brennelement- und Bestrahlungstechnologie). Jul 1974. 101p. (In German). INIS.

The relationship between the equivalent fission neutron flux density above 1 MeV, measured by means of the activation reaction $^{58}Ni(n,p)^{58}Co$, and the fissionable fuel inventory in all 25 fuel channels of the research reactor FRJ-2 is regression-analytically investigated. According to sensible assumptions as to the thermal neutron flux density in the fuel zone, one can predict the equivalent nickel fission flux density on the basis of fissionable fuel content of the inserted fuel element, with a maximum deviation of 12%. Without considering the actual fuel mass, a variation range of the total expected measured values of the equivalent nickel fission flux density of 50% was obtained. This flux density, therefore, can be given considerably more accurately with the help of the dependence found on the fissionable fuel content than is possible by mere consideration of the measured variations without taking the uranium mass into account. The necessary information for the prediction of the equivalent nickel fission flux density in all 25 fuel channels is presented. (GE)

2416 (JUL-1111-RG) INVESTIGATIONS ON HTR-HEAT EXCHANGER MATERIALS. Serpekian, T. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Sep 1974. 174p. (In German). Dep. NTIS (US Sales Only) $11.75.

Thesis. Submitted to Technische Hochschule, Aachen.

In the scope of the projects "THTR" and "Process Heat Reactor" an experimental facility has been built up as a contribution for the development of high-temperature reactors. Laboratory-scale experiments were performed on boiler and heat exchanger materials. Special attention was given to the assessment of the hydrogen amount delivered into the primary helium coolant circuit. Hydrogen was set free by the oxidation of the metal by the secondary coolant at the inner surface of test tubes. In the next step it premeates the tube wall and reaches the outer surface of the tube which is in contact with the primary coolant. The specimens were capsules made out of tubes of different materials. Furthermore the carburization of boiler materials by low concentrations of carbon monoxide as impurity in the coolant gas was investigated. Supplementary some measurements on hydrogen permeation through such tubes were performed. A brief discussion on the coolai chemistry of helium and water as well as a discussion of some surface phenomena is included. A description of the apparatus and the experimental method follows. The results of hydrogen delivery measurements and of metallographic investigations are presented. It is shown that under specific conditions the boiler tubes would not carburize. On the contrary, they might, however, be decarburized by hydrogen permeating through the tube wall. The amount of hydrogen delivered into the primary circuit of the THTR under normal conditions can be managed well by means of the gas-purification plant. (auth)

2417 (NAA-SR-9400(Vol. 4)) LITHIUM HYDRIDE TECHNOLOGY. IV. A Novel Neutron-Gamma Material for SNAP Shielding Applications. Welch, F. H. (Atomics International Div., Canoga Park, Calif. (USA)). 25 May 1967. Contract AT(04-3)-701. 33p. Dep. NTIS $4.75.

Declassified 4 Nov 1971.

A novel neutron-gamma shielding material was conceived which consists of a matrix of cast lithium hydride, containing a crushed, granular gamma shielding material. The concept was tried with two different gamma materials. In one version tungsten alloy was used; in the other zirconium hydride was the gamma material; in both cases the less expensive, most available form of the gamma material was used. Densities, compositions, and N_H's of the two shielding combinations were determined. Modulus of rupture tests indicated that both cast aggregate material combinations were weaker than the cast lithium hydride. An experimental shield was successfully fabricated containing a 200-lb layer of tungsten alloy, infiltrated with cast lithium hydride. The process is believed feasible for the fabrication of future large reactor shields. (auth)

2418 (ORNL-TM-4814) NEUTRON FLUX COMPUTATIONAL MODEL OF THE OAK RIDGE RESEARCH REACTOR. Allen, E. J.; Kerr, H. T. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 32p. Dep. NTIS $4.00.

A computational model of the Oak Ridge Research Reactor (ORR) is described which calculates seven-group neutron fluxes at all positions in the core. The model's multigroup cross-section data has been processed from ENDF/B-IV by the AMPX modular system and the neutronics calculation is performed by the diffusion-theory code VENTURE. An auxiliary code is described which simplifies and constructs the VENTURE input thereby allowing routine use of the calculational model. The adequacy of the model was established through direct comparison of calculated and experimentally measured activities for flux monitors in a specified core configuration; the agreement was generally within 10 percent. (auth)

2419 (ORNL-TM-4868) FISSION RATE DETERMINATION OF SIMULATED FTR STORED FUEL FOR THE FAST REACTOR EXPERIMENTAL SHIELDING PROGRAM. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 39p. AT.

The experiments performed at the Tower Shielding Facility which simulated the neutron induced fissions that occur in the FTR stored fuel are described. This experiment was designed to provide experimentally determined fission rates which would be utilized to verify the theoretical models normally used to describe stored fuel activity. Hydrogen counter, NE-213 spectrometer, and Bonner ball measurements were made of the neutron transmissions through the various experimental configurations. In this experiment, nearly all neutrons above 1 MeV were produced by fissions in the stored fuel. This was clearly demonstrated by including experimental configurations which contained "dummy fuel" in place of the ^{235}U fuel assemblies. (auth)

2420 (RCN-223) PRESSURIZED WATER LOOP IN THE HIGH FLUX REACTOR AT PETTEN. de Graaf, F. A. M.; Visser, J. F. J. (Stichting Reactor Centrum Nederland, Petten). Feb 1975. 24p. Dep. NTIS (US Sales Only) $6.75.

A description is given of an in-pile loop for the irradiation of fuel pins under similar working conditions as those in pressurized water reactors. The working pressure of the loop is 140 bar and the water temperature at the inlet of the in-pile section is 280°C. The primary cooling water flow is 15 m^3/hr. The in-pile section of the loop can be loaded with two test experiments. A large number of irradiations on fuel bundles has been carried out under various conditions of linear powers and burn-ups. It is also possible to irradiate single fuel pins in a reloadable three-pin fuel bundle, so that intermediate measurements can be performed. A short survey covering the operational experience and irradiation programs up to the end of 1974 is presented. The working conditions, flow sheet and lay-out of the loop are discussed to some detail, with emphasis on the in-pile part of the loop. The purpose of this report is to provide information concerning this irradiation facility to future customers. (auth)

2421 (RT/FI-(74)46) POWER TRIGA CALIBRATION BY THERMAL METHOD. Verri, A. (Comitato Nazionale per

l'Energia Nucleare, Rome (Italy)). Nov 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

The object of the present work is an analysis of a procedure allowing the increase, in the limits of experimental approximation, the thermal power of a TRIGA Reactor or, generally, of a swimming pool reactor, recovering the heat escapes which here take up the form: $F(T) = F_0(T-T_0)$, where F_0 is a constant and T_0 is a temperature, both obtained with experimental methods. 3 references. (auth)

2422 (TID/SNA-1645) REMOTELY OPERATED TEST EQUIPMENT FOR MATERIALS TESTING AT COMBINED CRYOGENIC AND NUCLEAR RADIATION ENVIRONMENT. Weleff, W.; McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1965. 33p. Dep. NTIS $4.75.

The major design features of a remotely operated test equipment for testing of materials in a combined environment of liquid hydrogen and nuclear radiation are presented. This equipment consists of tensile pulling assemblies, cryostats, pneumatic and hydraulic systems and the necessary instrumentation. Description of this equipment and comments on the operating procedures are made. The equipment was utilized to obtain tensile and shear strength properties of various alloys in this environment. The raw data obtained is exceptionally good and corresponds to data obtained with standard tensile test equipment. (auth)

2423 (WANL-TMI-430) DOSE RATE FROM PTX EXPERIMENTS IN THE WREC FACILITY. Ricks, L. O.; Sipush, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Dec 1962. 4p. Dep. NTIS $4.00.

The total gamma dose rate outside the 4.5' concrete wall is expected to be less than 10 mr/hr with a low energy neutron flux less than 60 n/cm^2-sec. These values are based on calculated NRX values normalized to previous measurements made for a Yankee critical assembly. The unnormalized dose rate was calculated to be less than 1 mr/hr for both neutrons and gammas. Based on the normalized values, which are the higher, the present wall is adequate. (auth)

2424 A FISSION GAS SEPARATOR WITH A CLOSED CIRCUIT NITROGEN LOOP. Stechemesser, H.; Heinrichs, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Allgemeine Technologie). Kerntechnik; 16: No. 12, 528-532(Dec 1974). (In German and English).

A fission gas separation system for fuel assembly irradiation experiments requires cooling of adsorption traps with liquid nitrogen. In order to reduce the dependence of this cooling on stored liquid nitrogen, a closed circuit nitrogen recycling loop was developed, with a cryogenic machine for the liquefaction stage. The design and mode of function of the adsorption traps, of the vacuum system, and of the nitrogen loop as a whole are described. (auth)

2425 AUTOMATIC NEUTRON AND GAMMA FLUX DENSITY MEASURING DEVICE WITH COMPUTER CONTROL. Schmidt, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Kerntechnik; 16: No. 12, 534-537 (Dec 1974). (In German and English).

An automatic measuring device used for measuring neutron and gamma flux densities in the research reactor FRJ-2 is described. The measuring device is controlled, and the measured data are processed, by a process computer (Siemens 301). The method results in substantial savings of work and time in routine measurements, e.g., for burnup determinations. (auth)

2426 ACOUSTIC MEASUREMENTS IN THE EBR-II REACTOR PRIMARY SODIUM TANK. Anderson, T. T.; Gavin, A. P.; Bobis, J. P. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 671-675(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Two sodium-immersed detectors, a microphone and an acoustic waveguide, have been developed, installed, and used for monitoring acoustic background of Experimental Breeder Reactor No. II (EBR-II). The microphone signal is free of structural resonances which appear in the signals from accelerometers mounted on the waveguide and various reactor components. Sound pressure level decreased by an order of magnitude when the primary sodium coolant flow was reduced from 100 percent to 50 percent. At full flow and independent of reactor power, the 1-millibar r.m.s. sound pressure as sensed by the sodium-immersed microphone had the characteristics of wideband noise over the frequency range 0.6 to 40 kHz. 7 references. (auth)

2427 NUCLEAR DETECTION INSTRUMENTATION FOR REACTIVITY MEASUREMENTS WITH THE FAST FLUX TEST FACILITY ENGINEERING MOCKUP CORE. Mathis, M. V.; De Lorenzo, J. T.; Chiles, M. M.; Mihalczo, J. T. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 691-695(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Four multichannel detection systems, two operating in an integrated current mode and two in a pulse mode within the engineering mockup core for the Fast Flux Test Facility reactor, successfully furnished signals during a 5-month reactivity surveillance procedures experiment for evaluation of reactivity measurement methods and associated instrumentation for Liquid Metal Fast Breeder Reactor applications. In addition, the adequacy of the low level flux monitor design for the Fast Flux Test Facility was verified. 15 references. (auth)

2428 KNK REACTOR OPERATIONS EXPERIENCE AND RELATED EXPERIMENTAL PROGRAMS. Marth, W.; Brudermueller, G.; Guthmann, E.; Mausbeck, H. Trans. Amer. Nucl. Soc.; 20: 168-169(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2429 KNK STEAM GENERATOR DAMAGE. Lorentz, H.; Herberg, G. Trans. Amer. Nucl. Soc.; 20: 200-202(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2430 UTILIZATION OF THE OSIRIS RESEARCH REACTOR FOR STUDIES OF FUEL BEHAVIOR IN ACCIDENTAL CONDITIONS. Breant; Zecevic; Marfaing; Graf. Trans. Amer. Nucl. Soc.; 20: 451-452(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2431 UTILIZATION OF PEGASE FOR THE STUDY OF HTGCR AND LMFBR SAFETY PROBLEMS. Eckert, R.; Lurie, R.; Desandre, C.; Urlacher, C.; Marin, F.; Gouirand, J. M. Trans. Amer. Nucl. Soc.; 20: 452-454(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2432 NONDESTRUCTIVE ANALYSIS OF FUEL BURNUP OF IRRADIATED TSING HUA OPEN POOL REACTOR SPENT FUEL BY SOLID STATE FISSION TRACK DETECTOR. Cheng, C. H.; Yuan, L. J.; Yang, J. T. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 199-203 (Dec 1974).

A feasibility study to determine the burnup of a spent fuel has been carried out by measuring the amount of fission neutrons released from a spent fuel while it is exposed in a well thermalized constant neutron field. Since the fission density of the exposing fuel is inversely proportional to the fissile depletion, therefore, to measure the fission neutron distribution of the fuel is more significant. In this work, solid state fission track detectors were used for the measurement. The percentage burnup distributed along the spent fuel was obtained, which agrees with the calculated result from the irradiation history. (auth)

2433 TEMPERATURE COEFFICIENTS AND POISON EFFECTS OF TAIWAN RESEARCH REACTOR. Ho, L. W.; Cheng, C. K. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 204-215(Dec 1974).

Temperature coefficients and poison effects of TRR are described. In the experiment the reactivity loss of fuel rods as the average coolant temperature raised from 21°C to 63°C was −1.19 mk, and as the average moderator temperature raised from 20°C to 55°C was −2.40 mk. The average values of coolant and moderator temperature coefficients were -3.0×10^{-2} mk/°C and -6.8×10^{-2} mk/°C, respectively. The reactivity loss by prompt poison was −2.20 mk during startup from 0 to 40 MW. The average value of prompt poison was -5.5×10^{-2} mk/MW. The reactivity loss by equilibrium xenon poison during reactor operation was −10.31 mk, −15.61 mk, and −18.72 mk at the power levels of 10 MW, 20 MW, and 30 MW, respectively. The maximum poisoning of xenon and samarium after reactor shutdown from the power levels of 20 MW and 35 MW were −19.73 mk and −33.17 mk, respectively. Comparison between theoretical and experimental results are fairly consistent. 7 references. (auth)

2434 PRELIMINARY STUDY OF ^{41}Ar EXPOSURE DOSE IN THE OPERATION OF TAIWAN RESEARCH REACTOR. Su, S. J.; Chiu, J. H.; Lee, Y. H. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 189-198 (Dec 1974).

The calculation of the ^{41}Ar exposure dose around the TRR stack at various distances and directions was precisely calculated with an electronic computer. The concentration in the radioactive clouds was assumed to be of the Gaussian plume

model, of which the cloud size parameters were formulated by the present study on the basis of Pasquill's graphical data. The annual doses (from May 1973 to May 1974) measured around TRR by $CaSO_4$(Dy) dosimeter are also reported to compare with the calculated results. (10 references) (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 2486.

2435 (DUN-3272) HIGH TEMPERATURE PERFORMANCE OF TWO N REACTOR FUEL ALLOYS, A PARTIAL FINAL REPORT ON PRODUCTION TESTS 8 AND 13. Evans, T. W. Douglas United Nuclear, Inc., Richland, Wash. (USA)). 30 Jun 1967. 48p. Dep. NTIS $5.50.

Declassified 27 Mar 1975.

An apparently small change in fuel composition was made when N Reactor fuel production was converted from an iron–silicon alloy of uranium in the Mark I design to an iron–aluminum alloy in the Mark II design. This report reviews the events that led up to the change and presents fuel swelling data from two production tests (PT-8 and 13) involving Mark II prototype elements in which both fuel compositions were involved. These data provided significant support for the decision to change fuel alloys. (auth)

2436 (HW-81327) PRODUCTION TEST NR-8, COPRODUCER DEMONSTRATION TEST (1.25). Evans, T. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 4 May 1964. 15p. Dep. NTIS $4.00.

The objectives of this test are: (1) to demonstrate the capability of producing both tritium and weapons grade plutonium with a tube-and-rod fuel-target element in N Reactor, and (2) to evaluate the in-reactor performance of tubular uranium fuel and of lithium-bearing target elements. (auth)

Propulsion and Package Reactors

Refer also to abstracts 361, 382, 383, 385–398, 400–408, 410, 411, 413–436, 600–604, 617–619, 653, 657, 937, 948, 950–956, 964, 968–972, 1272, 1287–1289, 1329, 1330, 1339, 1343–1346, 1368, 1369, 1387, 1406–1413, 1517–1526, 1549, 1569–1573, 1581–1583, 2255, 2692–2697, 2718, 2845–2857, 2859, 2860, and 2922.

2437 (ACF-411-191) KIWI B PRESSURE VESSEL 6061 NO. 5 AND ROCKETDYNE RN-6 NOZZLE STRUCTURAL PROOF TEST REPORT. Hanks, J. G. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 19 Dec 1963. 135p. Dep. NTIS $9.75.

The results of the structural proof test conducted on the Kiwi B 6061 No. 5 Pressure Vessel and the Rocketdyne RN-6 Nozzle are presented. The objectives of this test were to verify the structural integrity of the system, to demonstrate the validity of current analytical methods, and to demonstrate a mode of failure. The first two objectives were met satisfactorily but a failure test was not possible at this time due to other agencies having a need for the RN-6 Nozzle in future tests. The test was terminated for data analysis at 80% of proof load due to indicated yielding at the inside surface of the fillet radius of the RN-6 Shear Lip. Data analysis showed permanent strain in the shear lip did not exceed the 0.2% yield strength of the Inconel-X material. The average maximum rotation was 0.0039 radians for the nozzle and 0.0044 radians for the vessel. The maximum axial displacement was 0.059 inches for the nozzle and 0.042 inches for the vessel. The average maximum radial displacement was 0.0115 inches for the nozzle and 0.007 inches for the vessel. These maximum rotation and displacement measurements were taken as near as practical to the joint interface. The maximum stress in the nozzle end of the vessel was 21,000 psi and the maximum stress in the nozzle, other than the shear lip, was 51,000 psi. A maximum strain of 5,200 μ in/in was indicated at the inside surface of the fillet radius of the RN-6 shear lip. (auth)

2438 (AD/A-002655) RESULTS OF WORK ON THERMOEMISSION CONVERSION. Karetnikov, D. 20 May 1974. Translation of Paper Presented at an International Meeting on Thermionics, Vienna, 1972. (FSTC-HT-23-147-74). 5p. NTIS $3.25.

Tests of the topaz-3 thermionic reactor, similar in design to its 2 predecessors, began in 1972. By 1 March 1973, it had operated about 3000 h at 5-7 kV, and efficiency was 30% higher than that of the first reactors. At the same time, tests of 1- and 5-element generating channels were conducted, with a 5-element channel operating for over 3000 h at 1.7 w/cm^2. A single element with tungsten-rhenium emitter and niobium collector operated 2670 h with initial power density of 7 w/sq cm dropping to nearly 3.5 w/cm^2 by the end of the test. Unexpectedly great reduction in neutral component concentration was found in theoretical-experimental study of nonstationary cesium plasma. A triode thermionic converter, as a high-temperature thyratron, using a cesium-barium mixture at low pressure can close the circuit at up to 100 V, cathode temperature 1600°C, current density up to 20 a/cm^2 and voltage drop of not over 5 V. (GRA)

2439 (AGC-2414(Vol.2)) SECONDARY GAS GENERATOR SYSTEM, PRELIMINARY DESIGN. Volume II. Final Report (Appendices). Haygood, J. M. (Aerojet-General Corp., Azusa, Calif. (USA)). Nov 1962. 213p. Dep. NTIS $13.75.

The use of these gas generators to aid in the disposal of the hydrogen from NERVA engine testing was considered and the specifications of a preliminary design are reported. This approach was abandoned in favor of steam generators. (LTN)

2440 (AGC-2585) EVALUATION AND COMPARISON OF ALTITUDE CONTROL SYSTEMS FOR SPACECRAFT WITH NERVA ENGINES (REVIEW). (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Jul 1963. 11p. Dep. NTIS $4.00.

2441 (AI-AEC-12729) SNAP REACTOR PROGRAMS. Progress Report, May–July 1968. Asquith, J. G. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Sep 1968. Contract AT(04-3)-701. 98p. Dep. NTIS $8.00.

Declassified 4 Mar 1975.

Progress is reported in the following areas: fuel development; component development; S8DR development; reference ZrH reactor studies; thermoelectric system studies; and aerospace nuclear safety. (JWR)

2442 (AI-AEC-12773) SNAP REACTOR PROGRAMS. Progress Report, November 1968–January 1969. (Atomics International Div., Canoga Park, Calif. (USA)). 1969. 135p. Dep. NTIS $9.75.

Declassified 24 Mar 1975.

Progress is reported in the following areas: S8DR development; reference ZrH reactor engineering; thermoelectric system engineering; thermoelectric converter development; component development; fuel development; and aerospace safety. (JWR)

2443 (AI-AEC-12975) SNAP REACTOR PROGRAMS. Progress Report, May–July 1970. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Sep 1970. Contract AI(04-3)-701. 162p. Dep. NTIS $11.25.

Declassified 6 Sep 1973.

Activities reported include the following: 58 DR testing; reference zirconium hydride reactor engineering; thermoelectric system engineering; compact thermoelectric converter development; component development; and aerospace nuclear safety. (JWR)

2444 (APEX-262(Del.)) CONCEPTUAL DESIGN OF A NUCLEAR-POWERED BALLISTIC MISSILE. Cooley, W. C. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 31 Jan 1955. 72p. Dep. NTIS $6.75.

Declassified 4 Mar 1975.

A conceptual design is presented for a two-stage intercontinental ballistic missile with a nuclear-powered first stage and a chemically-powered second stage. It is designed to deliver a 3000 pound bomb at a range of 5500 nautical miles with a maximum velocity at power cutoff of 23,000 feet per second. The nuclear rocket power plant (designated AC-300) utilizes liquid hydrogen as the working fluid. The gasoline and liquid oxygen propellants in the second stage provide radiation shielding for the bomb and guidance equipment. The reactor is to be made primarily of graphite and to operate at a maximum surface temperature of 5000°F and an inlet pressure of 1000 psia. The operating time is three minutes at a power of 10,000 megawatts. The U-235 investment is approximately 100 pounds. The specific impulse of the nuclear stage is estimated to be approximately three times as high as for a chemical rocket power plant utilizing gasoline and liquid oxygen. This improvement is due to the low molecular weight of hydrogen as compared with the products of chemical combustion. The takeoff gross weight is estimated to be ~200,000 pounds. (auth)

2445 (FZK-344(Add.)) NERVA IRRADIATION PROGRAM. ASTR IN-PILE-TUBE TEST 1. Pressure Transducers (Test 23/R512A). Lewis, J. H.; Bullock, R. E. (General Dynamics/Fort Worth, Tex. (USA)). 2 Dec 1968. 21p. Dep. NTIS $4.25.

2446 (GA-8901) RESEARCH AND DEVELOPMENT ON FISSION-HEATED THERMIONIC CELLS FOR APPLICATION TO NUCLEAR SPACE POWER SYSTEMS. Summary Report for Period October 1, 1967–February 29, 1968. (Gulf General

Atomic Co., San Diego, Calif. (USA)). 1968. Contract AT(04-3)-167. 74p. Dep. NTIS $6.75.
Declassified 4 Mar 1975.
The major accomplishments for the five month period included: fabrication and testing of the Mark VIIB IC-C1 (FEI-5), the first converter with a 1.1 inch diameter emitter; testing of the UO_2 fueled Mark VI IC-UO_2 (IC-15) for 5369 hours of operation at an average power density of 10 W/cm^2; fabrication of four converters for the first test of clustered converters; and fabrication of 82 fuel elements for the first nuclear criticality experiment. 6 references. (auth)

2447 (GA-8986) OUT-OF-PILE OPERATION OF FOUR CONVERTERS IN A REACTOR CONFIGURATION. Yates, M. K.; Fisher, C. R.; Schwarzer, D. E. (Gulf General Atomic Co., San Diego, Calif. (USA)). 28 Feb 1969. Contract AT(04-3)-167. 61p. Dep. NTIS $6.25.
Declassified 21 May 1975.
A cluster of four thermionic fuel elements simulating a segment of a thermionic reactor was tested to study the effects of mechanical and electrical interactions between fuel elements through the interconnecting leads and the effects of ribbon duct NaK coolant passages coupled to thermionic cells. The average overall efficiency of the cluster was 7.0% with a net power output of 333 watts and a total power input of 4750 watts. The converters were operated at 8 A/cm^2 current density and a power input of 1200 watts (47 watts/cm^2 of emitter area). Output power densities at converter leads averaged around 3.5 watts/cm^2 at estimated emitter temperatures of 1600°C. The power output of the liquid metal cooled cluster was constant over the 68 hr test period except when the coolant temperature was changed. No problems were encountered with the inter-connecting leads or with the thermal and mechanical design of the heat sink. (auth)

2448 (GEMP-485) 710 REACTOR-SHIELD STUDY SUPPORT FOR MANNED SPACECRAFT APPLICATIONS. Simpson, J. D. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Apr 1967. Contract AT(40-1)-2847. 314p. Dep. NTIS $18.75.
Declassified 6 Sep 1973.
The study described was performed to determine the influence of Brayton cycle space power systems requirements on the design of the 710 fast-spectrum, refractory metal reactor. The intent was to provide specific guidelines and areas of emphasis which should be applied to the 710 reactor development program in order to maximize the relevancy of development being conducted on the reactor. The application selected for the purpose of this study was that of a manned orbiting space station with significant EVA operational requirements. The space station was assumed to have an operating life considerably in excess of any single powerplant and thus consideration was given to powerplant replacement techniques and methods. The power level selected for this study was 200 kW(e). As a result of previous studies on the reactor powered Brayton cycle study, this study was conducted on the basis of a separate loop being used for waste heat dissipation, therefore, a two-loop system resulted with power conversion machinery in the reactor loop. This isolation of the reactor from the radiator was incorporated on the basis that fission product leakages above certain levels could result in an additional biological radiation burden to the space station crew. (auth)

2449 (GESR-2115(Vol.1)) THERMIONIC REACTOR POWER PLANT DESIGN STUDY. Volume I. Study Results. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). Dec 1968. Contract AT(04-3)-189. 241p. Dep. NTIS $15.25.
Declassified 31 Aug 1973.

2450 (GESR-2115(Vol.2)) THERMIONIC REACTOR POWER PLANT DESIGN STUDY. Volume Two. Supporting Analyses. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). Dec 1968. Contract AT(04-3)-189. 315p. Dep. NTIS $18.75.
Declassified 29 Apr 1975.

2451 (GESR-2121) DESIGN STUDIES OF 50- AND 100-kW(e) THERMIONIC POWER PLANTS. Louie, W. N.; Robertson, C. S.; Sawyer, C. D.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). Nov 1969. Contract AT(04-3)-189. 179p. Dep. NTIS $12.00.
Declassified 21 Mar 1975.
Information on a nuclear thermionic power plant in the SO-100 kW(e) power range for an unmanned, shadow shielded space mission is presented concerning the common bases for alternate design intercomparison studies, minimum critical mass ^{235}U fueled fast reactor, ^{233}U oxide fueled fast reactor, fast drive reactor, moderated reactor, comparison of alternate designs, recent fast reactor design studies, and description of reference design. 24 references. (DCC)

2452 (GTR-13) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 8 Jun 1964. 40p. Dep. NTIS $5.00.
Strain gages, thermocouples, ceramics, etc. were irradiated in the GTR reactor for 290 MW-hr. The insulation resistances of most of the strain gages decreased considerably during the test. The thermocouples changed moderately during the test. The spring properties of the control drum plate section did not change. Preliminary data suggested the piezoelectric ceramic discs were incapacitated after the test. Further data will be given in the final report. (LTN)

2453 (GTR-16) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 14 May 1965. 103p. Dep. NTIS $8.25.
The individual radiation effects tests were numbered 37/A002, 37/A003, 37,A004, 37/W401, 37/W202, and 15/W401. Tests 37/A002 and 37/A003 were the irradiation and postirradiation tensile and shear tests of metallic specimens submerged in LH_2. Test 37/A004 was a thermal conductivity test of metal specimens at LH_2 temperature. The test was cancelled during the pre-irradiation control tests because of malfunctions in test hardware. Test 37/W401 was an irradiation test of metallic and graphite tensile specimens. All specimens were irradiated in LN_2. The irradiated specimens will be tested in tension; some in LN_2 (−320°) and others at elevated temperatures up to 1290°F. This test also included the static irradiation of four resistivity specimens and four spring specimens. Postirradiation mechanical and electrical tests will be conducted on these items. Test 37/W202 included the irradiation of unfueled fuel-element segments containing cemented orifices at liquid nitrogen temperature and at ambient air temperature. The irradiated orifices will be subjected to postirradiation tests. Test 15/W401 was a test of two O-ring test fixtures irradiated in gaseous hydrogen. During the irradiation, one fixture was held at approximately −400°F. The other fixture was irradiated at ambient air temperature. Post-irradiation tests on the O-rings will be made. A description of the test plan, procedures, hardware, instrumentation, and dosimetry is presented. A portion of the postirradiation test data from the above tests is included. (auth)

2454 (LA-3212-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING NOVEMBER 30, 1964. (Los Alamos Scientific Lab., N. Mex. (USA)). 31 Dec 1964. Contract W-7405-ENG-36. 114p. Dep. NTIS $8.75.
Declassified 28 Aug 1973.
The KIWI-B4E reactor was performance tested with two full power tests of 8 and 2½ minutes. Operation was smooth, including reactor startup and shutdown. It has been disassembled and given a postmortem examination. Fourteen fuel elements were corroded or broken. The design of PHOEBUS-1 and PHOEBUS-2 is described, with special emphasis on fuel element fabrication and mockup construction. Fuel element development work is described with emphasis on fuel particle and fuel element coatings. Related phase studies are reported briefly. Items treated briefly are: fuel element corrosion by hydrogen studies, radiography, instrumentation, phase studies, alloy development, stress analysis, heat transfer, plasma research (for high specific impulse), reactor destruct experiments, etc. (LTN)

2455 (LAMS-2659) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING DECEMBER 20, 1961. (Los Alamos Scientific Lab., N. Mex. (USA)). 26 Jan 1962. Contract W-7405-ENG-36. 65p. Dep. NTIS $6.25.
Declassified 29 Aug 1973.
KIWI-B1A was tested. Before the full power test, 5 experimental plans were carried out. In one of these a faulty valve resulted in a hydrogen leak which caused an explosion. After correction and replacement of the graphite, a full power run was attempted. This was not successful and resulted in a considerable loss in reactivity, so far unexplained. The second power run was more successful, but had to be terminated due to a fire caused by leakage past an aluminum O-ring seal. Progress on KIWI-B2A is covered (pressure vessel, reflectors). Good progress is being made in the fabrication and coating of fuel elements for KIWI-B4A. Test cell operations are summarized and certain test cell improvements noted. Phase studies, testing methods, instrumentation developments and destruct experiments (in connection with flight safety) are treated briefly. (LTN)

2456 (NDS-13(Vol.3)) MILITARY SPACE OPERATIONS, 1975–1995. Military Applications of Solid Core Nuclear Rocket Engines in Geo-lunar Space. Volume III. Supporting Data.

(Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1969. 629p. Dep. NTIS $34.50.

Supporting data concerning military applications of solid core nuclear rocket engines in geo-lunar space are presented. (JWR)

2457 (NTO-I-0042) NRX/EST TEST SERIES SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 10 Nov 1965. 111p. Dep. NTIS $8.75.

This document presents support operational requirements for the NRX/EST Test Series and is a single source reference for much of the redundant material that would otherwise appear in the individual Experimental Plans. This document contains the requirements for: (1) operational and support teams; (2) experimental plan descriptions; (3) test assembly and facility limits; (4) test assembly and facility instrumentation and data; (5) communication nets; and (6) area control. The Test Cell "A" flow diagram, glossary of abbreviations, valve listings, pressure and temperature indicators, and control system schematics are given in the Appendices I through V. (auth)

2458 (NTO-R-0034) TEST PAD AND TEST CELL ACTIVATION SURVEY DATA NRX-A3. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 10 Sep 1965. 32p. Dep. NTIS $4.75.

A total of 1140 surveys were performed after the NRX-A3 Test Series on the Test Cell "A" Pad and surrounding area. Data obtained from the surveys showed that the radiation levels on the pad after the testing were considerably higher than had been experienced after any previous testing. The data indicated that the lead brick in the neutronic water tank window was one of the major, if not the major, source of high dose rates on the pad. It was further concluded that the source of the lead brick activation was antimony contained in the brick as a hardening agent. The activated lead bricks were removed from the window and lead bricks with an antimony content of less than .1% will be used as the water tank shield for subsequent testing. (auth)

2459 (NTO-R-0076) EXPERIMENTAL PLAN I TEST REPORT. NRX-A5 Test Series. Initial Criticality, Neutronics Calibration, Control Drum Worth Measurements, and Flow Tests. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 2 Jun 1966. 74p. Dep. NTIS $6.75.

Experimental Plan I of the NRX-A5 Test Series was performed on May 26, 1966, at the Test Cell "A" facilities. Significant operations included: Initial Criticality, Phase I Neutronics Calibration, Control Drum Worth Measurements, Response Measurements on the Power Controller, Ambient GH_2 Flow Test, Response Measurements on PCV-41 Pressure Controller, Cold GN_2 Flow Test and Scram LH_2 Flow Decay Tests. Three types of drum worth measurements were performed: (1) integral worth of drum number 2, (2) relative integral worth of each of the drums, and (3) banked differential worth near the critical drum position. Preliminary evaluation of these measurements indicated the drum worth agreed with the predictions and that the worths of the individual drums were essentially the same. All systems at the Test Cell and at the Control Point performed satisfactorily with no major anomalies noted. The performance of the facility turbopump was as expected with no significant leakage noted as was the case during the facility checkout test. The new INIS detectors and the eight decade neutronic system were used during these tests and the performance of the system was completely satisfactory. (auth)

2460 (NTO-R-0080) EXPERIMENTAL PLAN IV TEST REPORT. NRX-A5 Test Series. Second Power Test. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 28 Jun 1966. 62p. Dep. NTIS $6.25.

Experimental Plan IV of the NRX-A5 Test Series was performed on June 23, 1966, at the Test Cell "A" facilities. Significant operations included Fixed Drum Startup from 30 kW to near rated conditions and operation of the reactor at design point for approximately 14.3 minutes. The major test objectives were to operate the NRX-A5 Test Assembly at rated conditions for the maximum duration of the Test Cell fluid storage capabilities; to obtain data necessary to evaluate the effect of reactor design changes; to obtain additional data to evaluate the performance of the No-Flux Temperature Controller; and to perform from a low reactor power a fixed drum startup to near rated conditions. All objectives except the first were successfully carried out. Objective (a) was partially carried out in that a nominal full power operating time of approximately 14.3 minutes was achieved prior to reaching the drum position Test Parameter Limit of 145°. (auth)

2461 (NTO-R-0083) STEAM GENERATOR DEVELOPMENT TEST PROGRAM, EXPERIMENTAL PLAN VI. Test Report. McCarty, W. L. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Sep 1966. 126p. Dep. NTIS $9.50.

The ETS-1 Steam Generator System Development Test Program Experimental Plan VI was conducted between 28 April 1966 and 9 August 1966. The type of tests conducted during EP-VI were with two of the three modules of the Steam Generator System at full steam for short and long durations. Steam generator switching was attempted on several tests with limited success (generator switching is the shutting down of one module at full steam and the automatic full steam startup of the idling module). The first problem encountered during switching was an incomplete purge of combustible gases in second stage oxidizer line of the shutdown module which resulted in an explosion. The gaseous nitrogen purge was thus extended to all modules after shutdown. Another problem during switching was a second stage cutoff malfunction which was possibly caused by the reduced propellant tank pressures. The last test run was two modules at full steam for approximately 1000 seconds duration. The Steam Generator System was very stable during the run with no evidence of pressure or temperature fluctuations. The Steam Generator System was disassembled during and after the test program. The inspection during the test program revealed extensive deterioration of the welds in two injectors and warping of the combustion chamber inner liner in one module. The damaged parts were reworked and/or replaced with spares. The inspection after the test revealed no major discrepancy to the reworked or spare parts. (auth)

2462 (NYO-3873-2) THERMIONIC REACTOR DESIGN STUDIES. Final Report. Schock, A.; Abbate, M. J.; Eisen, C. L. (Fairchild Hiller Corp., Farmingdale, N. Y. (USA). Republic Aviation Div.). May 1970. Contract AT(30-1)-3873. 216p. Dep. NTIS $14.00.

Declassified 31 Aug 1973.

Conceptual designs for thermionic reactor power plants using external-fuel diodes in an in-core arrangement are presented. Designs for both manned and unmanned space missions are described. An out-of-core design is also presented. (JWR)

2463 (ORNL-TM-4825) DESIGN, FABRICATION, AND OPERATION OF CAPSULES FOR THE IRRADIATION TESTING OF CANDIDATE ADVANCED SPACE REACTOR FUEL PINS. Thoms, K. R. (Oak Ridge National Lab, Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 78p. (NASA-CR-134592). Dep. NTIS $7.00.

Fuel irradiation experiments were designed, built, and operated to test uranium mononitride (UN) fuel clad in tungsten-lined T-111 (Ta-8 percent W-2 percent Hf) and uranium dioxide (UO_2) fuel clad in both tungsten-lined T-111 and tungsten-lined Nb-1 percent Zr. A total of nine fuel pins was irradiated (four containing porous UN, two containing dense, nonporous UN, and three containing dense UO_2) at average cladding temperatures ranging from 931 to 1015°C. The UN experiments, capsules UN-4 and -5, operated for 10,480 and 10,037 hr, respectively, at an average linear heat generation rate of 10 kW/ft. The UO_2 experiment, capsule UN-6, operated for 8333 hr at an average linear heat generation rate of approximately 5 kW/ft. Following irradiation, the nine fuel pins were removed from their capsules, externally examined, and sent to the NASA Plum Brook Facility for more detailed postirradiation examination. During visual examination, it was discovered that the cladding of the fuel pin containing dense UN in each of capsules UN-4 and -5 had failed, exposing the UN fuel to the NaK in which the pins were submerged and permitting the release of fission gas from the failed pins. A rough analysis of the fission gas seen in samples of the gas in the fuel pin region indicated fission gas release-to-birth rates from these fuel pins in the range of 10^{-5}. (auth)

2464 (RN-A-0010) SUMMARY REPORT CY '67 FOR PERIOD ENDING 30 SEPTEMBER 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 598p. Dep. NTIS $33.00.

The major effort was directed toward mating XECF with ETS-1. Other progress involved delivery of the various items of NRX-A6, XECF, XE-1 and ETS-1 hardware to the test site, activation of the E-MAD hot and postmortem areas, and assembly of XECF in E-MAD. The test specification for XE-1 was completed in May. All XE-1 hardware was completed during CY 67 and shipped to NRDS, where assembly was started in the E-MAD cold area. Assembly has been suspended pending resolution of problems associated with the discovery of a small quantity of fuel-element particles in the core, inner reflector, seal strip, and control drum housing. At the close of the period, laboratory investigation and further disassembly were planned. The problem is expected to be resolved in sufficient time for the engine to be ready for testing prior to ETS-1 availability. An optimization program for the 200,000-lb thrust NERVA engine was completed in July 1967. At the end of CY 67 the NRX-A6 Reactor was in final assembly for shipment to NRDS early in CY 68. Primary effort on the NRX program was devoted to upgrading of the fuel endurance capability by WANL to ensure the achievement of the 60-min full-power full-duration objective for NRX-A6. As a

result of this program and the consequent delay in assembling an NRX-A6 reactor, the NRX-A6 power test date was delayed from July 1967 to December 1967. Progress in many other areas is described: test facilities, special equipment tests, radiation effects tests, controls and instrumentation, and design and planning of advanced equipment, etc. (auth)

2465 (RN-PA-0015) JOINT SHIELDING PRESENTATION TO SPACE NUCLEAR PROPULSION OFFICE AT CLEVELAND, OHIO, OCTOBER 29-30, 1968. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 184p. Dep. NTIS $12.25.

Slides presented at a shielding review meeting give a good idea of the shielding and its effectiveness and the overall design of NERVA as of this time. (LTN)

2466 (RN-Q-0050) QUARTERLY PROGRESS REPORT NO. 50 FOR THIRD QUARTER, CY 1969 COVERING THE PERIOD OF APRIL, MAY, AND JUNE 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Aug 1969. 372p. Dep. NTIS $21.75.

Work continued in three broad areas: the technology program, the NERVA flight-engine program, and various support activities. The highlight of the period in the technology area was the performance of XE-P at full power and rated conditions at ETS-1. The XE-P testing was highly successful, with the accomplishment of EP-III, -IV, and -V. A test run to intermediate power and a successful restart were achieved on 17 April. The full-power run at rated conditions was achieved on 11 June. A series of startup tests followed on 26 June. The objectives of the XE-P test series were met. These consisted of demonstrating a satisfactory startup to rated power, obtaining additional transfer-function measurements, and demonstrating a satisfactory normal shutdown after reaching full-power conditions followed by pulse cooling. (auth)

2467 (RN-S-0324) FINAL TEST SPECIFICATIONS FOR PHASE I-A OF THE COUNTERMEASURES RADIATION EFFECTS PROGRAM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 42p. Dep. NTIS $5.25.

The test specification presented herein describes in detail the irradiation tests to be performed at the General Electric Company Vallecitos Atomic Laboratory in fulfillment of Phase I-A of the NERVA Countermeasures Radiation Effects Program. (auth)

2468 (RN-S-0418(Bk.1)(Suppl.8)(Sec.9)) XE-P TEST PREDICTIONS. Supplement 8 to Section 9. Issuance of Phase III, Runs 24, 25, 26, and 27. (Aerojet-General Corp., Sacramento, Calif. (USA)). 11 Aug 1969. 42p. Dep. NTIS $5.25.

Common Analog Model (CAM) predictions of the operation of XE-PRIME in planned runs 2, 4, 5, 6, and 7 are presented. (LTN)

2469 (RN-S-0418(Sec. 10)(Suppl.)) XE-P TEST PREDICTIONS. Supplement to Section 10 (Transfer Function Tests). (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Aug 1969. 49p. Dep. NTIS $5.50.

Some 85 frequency response transfer function predictions of the response of one variable to a change in another are shown graphically, usually over a frequency range of 10^{-3} to 10^{+3} radians per second and with both the gain in decibels and the phase angle in degrees of the response given, for a variety of operating temperature and pressure conditions. (LTN)

2470 (RN-TD-0047) XE CONFIGURATION TURBINE BLOCK VALVE RANDOM VIBRATION TEST. Final Report. Mathews, J. P. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Aug 1969. 72p. Dep. NTIS $6.75.

To demonstrate adequacy of the Turbine Block Valve (TBV) design, the fullfillment of three basic test objectives was required. These objectives were: First, to demonstrate structural and mechanical integrity of the TBV, in random vibration environments, in each of three planes parallel to the engine radial, longitudinal, and tangential axes. The magnitude of vibration was to be greater than predicted engine TBV response to ensure that 30 min of vibration in each axis would result in a component wear or damage level equivalent to 70 min of vibration at predicted X-Engine TBV response levels. Second, to demonstrate functional operation of the TBV while being vibrated. Third, to provide additional demonstration of structural and mechanical integrity by subjecting the TBV to an additional 40 min of vibration in each of the three axes at vibration levels equal to the predicted X-Engine TBV response. The structural and functional capability of the TBV to withstand the X-Engine vibration environment was adequately demonstrated. Cracks that developed in the actuator LN_2 drip shield did not impair the functional capability of the TBV. The slight degradation of the titanium-carbide roller bearings used in the valve did not significantly affect TBV performance. The results of random vibration tests conducted on an XE configuration upper turbine-inlet-line assembly (TBV included) show that the TBV vibration response, due to predicted XE engine vibration input at the turbopump-to-turbine inlet line joint was considerably less than the predicted responses used as criteria for the TBV vibration test program. This suggests that the vibration levels to which the TBV was subjected in the tests may have been excessive, so the favorable results provide good assurance that the P/N 1117188-79 configuration TBV is acceptable for service in an X-Engine vibration environment. (auth)

2471 (RP-MR-0017) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD 1 MARCH–31 MARCH 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 28p. Dep. NTIS $4.50.

Progress is reported on the fabrication and testing of nozzles for the PHOEBUS-2 reactor. This included chemical simulation of expected nuclear firing conditions. The development of brazing methods and materials procurement efforts are mentioned. One of the test nozzles was damaged during testing as a result of the failure of the control system due to a loose patch cord. Several other tests performed as expected with only minor damage to the nozzle (mostly to the cooling tubes). (LTN)

2472 (TID-25287) PROCEEDINGS OF THE THERMIONIC CONVERSION SPECIALISTS CONFERENCE: MONTEREY, CALIFORNIA, OCTOBER 23–24, 1969. (Naval Postgraduate School, Monterey, Calif. (USA)). 1969. 288p. (CONF-691078-). Dep. NTIS $17.60.

Declassified 31 Aug 1973.

Separate abstracts are included for 16 of the 17 papers presented concerning fuel-emitter tests and analysis, thermionic reactor development programs, and thermionic converter tests and development. One paper was previously included in NSA and can be found in the NSA Report Number Index under TID-24818, pp 194-211. (DCC)

For abstracts of individual papers see: 2473–2488.

2473 (TID-25287, pp 7-31) SOME RECENT DEVELOPMENTS IN THERMIONIC FUEL-CLAD SYSTEMS. Yang, L.; Hudson, R. G.; Horner, M. H. (Gulf General Atomic Inc., San Diego, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Gross diffusion study showed that hyperstoichiometric UC (C/U = 1.05) containing 4 wt% tungsten was compatible with tungsten at 1800°C. On the basis of vacuum emission measurements, the operating temperature limit of fluoride tungsten clad 90UC-10ZrC (C/U = 1.04, tungsten concentration = 4 wt%) was found to be about 1950°C. The transport rates of uranium and zirconium from 90UC-10ZrC (C/U = 1.04 tungsten concentration = 4 wt%) through tungsten cladding at 1800°C were found to be dependent upon the grain structures of the cladding. Of the six types of tungsten claddings studied (columnar fluoride tungsten, modified fluoride tungsten, arc-cast tungsten, powder metallurgy tungsten, fluoride-chloride duplex tungsten and chloride tungsten), the columnar fluoride tungsten yielded the highest transport rates, while the chloride tungsten yielded the lowest transport rate, the difference being about two orders of magnitude. Similar studies made on columnar fluoride tungsten and fluoride-chloride duplex tungsten clad UO_2 at 1800°C showed that the uranium transport rate through the duplex tungsten cladding was about a factor of five lower than that through the columnar fluoride tungsten cladding. Neutron radiography and hot cell examinations of in-pile emitters showed that the achievement of dimensional stability of oxide fueled emitters requires the improvement in the thermal and mechanical designs of the emitter, and that the carbide fueled emitters seem to be capable of maintaining dimensional stability at temperatures of thermionic interest and for burnups exceeding that required for certain low power thermionic reactor application. (11 references) (auth)

2474 (TID-25287, pp 32-48) VISCOELASTIC STRESS ANALYSIS OF A THERMIONIC EMITTER. Gietzen, A. J. (Gulf General Atomic Inc., San Diego, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

An analysis of the deformation of a tungsten emitter due to thermal and mechanical stresses using a finite element viscoelastic method is presented. Thermal and elastic stress analyses done as prerequisites to the viscoelastic analysis are also discussed. The analysis focuses on effects in the clad alone, investigating the effects of internal gas pressure and thermal

cycling. The basis of the analytical method is presented along with the analytical formulations for the creep (including primary creep) and relaxation behavior of tungsten. The calculated effect of thermal stresses and of gas pressure within the emitter of a specific in-pile test (GGA Mark VIIB, C-1) is compared to observed phenomena. (12 references) (auth)

2475 (TID-25287, pp 49-65) IRRADIATION OF TUNGSTEN AND TUNGSTEN/RHENIUM CLAD; 90UC–10ZrC + wt-% W FUEL PINS. Horner, M. H. (Gulf General Atomic Inc., San Diego, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Tungsten and tungsten/rhenium clad fuel pins fueled with 90UC-10ZrC with 4 wt-% tungsten were irradiated to burnups of 2.13×10^{20} fission/cm^3 and 2.12×10^{20} fission/cm^3 respectively. Indicated cladding temperature during the irradiation was a maximum of 1820°C for the tungsten clad sample and 1765°C for the tungsten/rhenium clad sample. A dimensional evaluation of both samples showed little change of the tungsten clad sample. Results of metallographic examination, electron beam microanalyses, and analyses for retained fission gases for the tungsten clad sample are presented. The geometry and fabrication techniques for the fuel pins will be discussed. (7 references) (auth)

2476 (TID-25287, pp 66-74) IRRADIATION OF URANIUM–CARBIDE FUEL FORMS. Smith, J. R. (Lewis Research Center, Cleveland); Snyder, G. L. 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Two capsules containing uranium-carbide fuel forms are being irradiated to determine the suitability of this fuel for use in a high temperature reactor. Each capsule accommodates nine "doughnut-shaped" fuel pellets stacked inside a cylindrical tungsten container. Thermocouples in each capsule are used to determine the fuel temperature and heat flux. One capsule, contains 90 percent UC-10 percent ZrC fuel while the other contains 50 percent UC-50 percent ZrC. Irradiation is at a nominal fuel temperature of 1970°K. A neutron radiograph, taken of the 90 percent UC-10 percent ZrC capsule after a fuel burnup of 1.5×10^{20} fissions/cm^3 (5500 hr of irradiation), revealed that no measurable clad distortion has occurred. Irradiation is continuing until distortion or data anomalies terminate the test. (auth)

2477 (TID-25287, pp 75-88) FISSION-GAS ESCAPE FROM Mo–UO_2 FUEL. Reichelt, W. H.; Chaney, M. C.; Patrick, A. J.; Ranken, W. A. (Los Alamos Scientific Lab., NM). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

The amounts of ^{85}Kr and ^{137}Cs escaping from porous Mo-40v/o UO_2 fuel specimens have been measured after irradiation times of 3250 to 10,400 h at average temperatures ranging from 1550 to 1770°C. The measurements are made directly by collecting the gas escaping from entire fuel specimens during irradiation, and indirectly by separately determining the amount of gas retained in the Mo and UO_2 phases of several small sections of a fuel specimen and comparing these determinations with burnup measurements of the changes in ^{236}U and ^{235}U content of the fuel. The retention technique permits the correlation of gas escape (or retention) with the variation in dimensional increase and temperature along the length of the fuel specimen. The results indicate that higher gas-escape percentages (up to 70%) for a given fuel specimen are associated with greater dimensional increases and that both these quantities are larger for higher specimen temperatures. The measurements also demonstrate that cesium escapes from the cermet more readily than inert gases. (8 references) (auth)

2478 (TID-25287, pp 89-109) THERMAL MECHANICAL PERFORMANCE OF TFE EMITTER BODIES. Lloyd, W. R.; Wilkins, D. R.; Hill, P. R. (General Electric Co., Pleasanton, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Calculated results are presented for elastic stresses in TFE emitter bodies that are due to the temperature distribution on the emitter under nuclear thermionic operating conditions. Stress results are presented for emitter body end cap thicknesses and sidewall thicknesses in the 20 mil to 60 mil range. Stress results are presented for TFE operating characteristics that include cell thermal power inputs in the range of 600 watts to 1200 watts, cell average current densities of 6 amp/cm^2 and 10 amps/cm^2, cell neutron flux distributions typical of 3–cell TFE operating conditions in GETR and for a fuel to emitter body heat transfer rate distribution inferred from RML examinations of one cell of a 3–cell TFE. The effect that azimuthal temperature variations in the emitter can have on the stress levels in the emitter body is also discussed. Mechanically uncoupling the emitter body end caps from the sidewalls is shown to decrease the magnitude of the peak bending stress in the emitter sidewall near the free end cap by about a decade. (4 references) (auth)

2479 (TID-25287, pp 110-120) ANALYSIS OF TRANSPORT PHENOMENA AND PLUG FORMATION IN CENTRALLY VENTED UO_2 FUEL BODIES. Wilkins, D. R.; Ross, R. N.; Patterson, D. N.; Atcheson, D. B. (General Electric Co., Pleasanton, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

A theoretical analysis of transport phenomena and plug formation in centrally vented UO_2 fuel bodies exposed to a Cs cover gas is presented. Particular attention is given to the prediction of transient and steady state UO_2 and inert fission gas (Xe and Kr) loss rates and partial pressures in the isothermal cavity. The analysis is performed by writing mass and momentum balance equations for each of the several interacting species in the vent tube. Collisional coupling between the species, collisional interactions with the walls and evaporation and condensation of UO_2 from the vent tube walls are reflected in the analysis. Steady state performance results for a UO_2 central vent in the presence of Cs vapor are presented for a variety of operating conditions of interest in thermionic applications. A low temperature simulation experimental program is defined to verify the analytical model and results of its analysis are presented. Conclusions are reached concerning the performance characteristics of central vents. (auth)

2480 (TID-25287, pp 121-144) THERMIONIC REACTOR DEVELOPMENT STATUS AT GULF GENERAL ATOMIC INCORPORATED. Holland, J. W.; Perry, L. W. (Gulf General Atomic Inc., San Diego, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

The status of Gulf General Atomic Incorporated's development program of a thermionic reactor power system is reviewed and the results of recent studies of power plants for space applications are summarized. The first multicell thermionic fuel element is presently being assembled from cells similar to those tested for 5000 hours in-pile. A 100 kW(e) reactor experiment is in the planning and conceptual design phase. The first of a series of clean critical experiments has been completed. Design studies have indicated that U-235 fueled thermionic power systems for the 50 to 200 kW(e) range will weigh 6500 to 9500 lbs for unmanned, and 25,000 to 28,000 lbs for manned applications. (23 references) (auth)

2481 (TID-25287, pp 145-171) EXTERNAL-FUEL THERMIONIC REACTOR. Schock, A.; Abbate, M. J.; Eisen, C. L. (Fairchild Hiller Corp., Farmingdale, NY). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

A thermionic reactor design based on external-fuel diodes is described. These are cylindrical diodes, with the emitter external to the collector. The design is based on individually replaceable thermionic fuel modules, each consisting of a fuel element, diode, heat pipe cooling system, and fission gas collection chamber. The salient features of the reactor are discussed, the analytical approach is illustrated, and typical sizes and weights for a wide range of power levels are presented. (18 references) (auth)

2482 (TID-25287, pp 172-193) SPACE POWER SUPPLIES BASED ON ZrH_x-MODERATED THERMIONIC REACTORS. Frank, T. G. (Los Alamos Scientific Lab., NM). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

The progress made during the past year at Los Alamos in the design of ZrH_x-moderated thermionic reactors is reported. Our effort during the past year concentrated on a nominal 100-kW(e) design. Studies of power flattening, electric power-output, control systems and shaped-4π-shielded configurations for this design are discussed. The preliminary design of a heat-pipe-cooled reactor which can conveniently be incorporated into a semireplaceable system is also described. (4 references) (auth)

2483 (TID-25287, pp 194-211) LONG TERM OPERATIONS OF IN-PILE AND OUT-OF-PILE CONVERTERS. Yates, M. K.; Fitzpatrick, G. O.; Kay, J. Jr.; Schwarzer, D. E. (Gulf General Atomic Inc., San Diego, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Five cylindrical thermionic converters were tested in-pile to determine performance levels and long term performance stability. Two of the converters were of the Mark VI series with 13 cm^2 emitter area. Mark VI IC-I3 (IC-16) was fueled with uranium zirconium carbide. It operated for 4395 hours as a thermionic test at an electrode power density of 6.4 W/cm^2. Mark VI IC-I4 is fueled with uranium dioxide and has operated stably for 5001 hours at an average electrode power density of 6.3 W/cm^2. The other three in-pile converters are of the Mark VIIB series with 45 cm^2 emitter area. One converter, IC-C2 failed on start-up. The other two are still operating and have accumulated 5001 hours (IC-C3) and 2264 hours (IC-C11). Three converters have been tested out-of-pile during the past year. Two of the converters are of the Mark VI series and are a continuation of the NASA life test program. (8 references) (auth)

2484 (TID-25287, pp 212-231) PERFORMANCE SUMMARY OF TWO SINGLE CELL IN-PILE (SCIP) CONVERTERS. Gelhaus, F. E.; Clark, A. F. (General Electric Co., Pleasanton, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

The performance of two converters is summarized and analyzed. Together they have accumulated over 15,000 hours of in-pile operation. SCIP 518 has operated over 8,000 hours and SCIP 519 has operated over 7,000 hours. The d.c. output of both converters has remained within 80 percent of the reference value: 6.8 watts/cm^2 at 1600°C for SCIP 518; 6.75 watts/cm^2 at 1630°C for SCIP 519. Both devices have a fluorine CVD tungsten emitter (0.460 inch dia.), a nickel collector (0.007 inch cold gap), and approximately 8.5 cm^2 of active area. SCIP 518's nonvented emitter contains a fuel body which is composed of an alternating stack of 25 percent enriched, cored UO_2 wafers and 0.010 inch tungsten disc fins. These fins reduce the maximum fuel temperature and the radial temperature gradient. SCIP 519's vented (0.005 inch dia.) emitter contains cored, 16 percent enriched UO_2 pellets, and two W–5% Re/W–26% Re thermocouples on the emitter end cap. The experimental evidence of the accumulation of xenon and krypton in the interelectrode volume of SCIP 519 is presented and compared with results from SCIPTH, a two-dimensional heat transfer computer program. The SCIP 518 venting at 3385 life test hours is analyzed and discussed. Both test are continuing. (6 references) (auth)

2485 (TID-25287, pp 232-240) IN-PILE EVALUATION OF THERMIONIC FUEL ELEMENT DESIGNS. Holtslag, D. J.; Street, G.; Clark, A. F. (General Electric Co., Pleasanton, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

A major part of the work performed by the Nuclear Thermionic Power Operation of General Electric Company under contract to the Atomic Energy Commission is the evaluation of prototypical thermionic reactor hardware designs through in-pile operation of fission fueled multicell thermionic fuel elements (TFEs). At the beginning of the past year, the operation of several TFEs was concluded and post-operational examination performed. Results were factored into the next series of experiments to expand the matrix of information. Currently, operation of this series of tests has been concluded and post-operational examination has begun. The hardware, operational history, port-operational observations and results obtained are described. (auth)

2486 (TID-25287, pp 252-266) FULL LENGTH THERMIONIC FUEL ELEMENT DEVELOPMENT. Kendall, W. W.; Samstad, G. I.; Gregory, T. L. (General Electric Co., Pleasanton, CA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

The preliminary design of an irradiation capsule for a Nuclear Thermionic Fuel Element (TFE) in the Hanford K Reactor is described noting the arrangement of the assembly in the reactor, the TFE with its electrical circuit, the vacuum provisions to the TFE, the cesium reservoir, and the NaK around the TFE. The assembly in the reactor includes an arrangement for adjusting the power of the TFE independent of reactor power operation. The preliminary design is the central focus of a series of tests: compatibility tests of the structural materials in the NaK capsule; the neutronics of the TFE and capsule; the assembly procedure for the 12-cell TFE; the processing parameters for the above assembly; the NaK capsule and NaK filling facilities; and the calorimeter fabrication and performance evaluation. (auth)

2487 (TID-25287, pp 266-277) DEVELOPMENT OF A FIVE LAYER SHEATH STRUCTURE FOR A BONDED AND SEALED TFE DESIGN. Dunlay, J.; Poirier, V. (Thermo Electron Corp., Waltham, MA). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

A sheath-insulator structure is described which uses a bonded heat transfer path between the collector and sheath tube and which is sealed to exclude cesium from the sheath insulator. The fabrication techniques established for the five-layer sheath structure are presented. The multi-layer structure consists of the collector, seal insulator, seal tube, sheath insulator, and outer sheath tube. Alumina-niobium cermets are used for the seal and sheath insulators. Gas pressure bonding and pressure brazing are employed to join the individual components together. Cross sections of experimental sheath structures are shown and the results of evaluations are summarized. (auth)

2488 (TID-25287, pp 278-286) EXTERNAL-FUEL CONVERTER TEST PROGRAM. Raab, B.; Schock, A.; Wolk, B. (Fairchild Hiller Corp., Farmingdale, NY). 1969.

From thermionic conversion specialists conference; Monterey, California, USA (23 Oct 1969).

Declassified 31 Aug 1973.

In proceedings of the thermionic conversion specialists conference.

Concurrent with the thermionic reactor design studies based on external-fuel converters, experimental programs for both out-of-pile and in-pile testing of such converters are underway. These employ double-ended cylindrical diodes, of 8-inch active length, with central water cooling. The converters for in-pile testing use tungsten revolver bodies, with six UO_2-filled fuel holes surrounding the central emitter hole. The design, fabrication techniques, test results, and current status of the above program are described. (auth)

2489 (TID/SNA-411) PROTOTYPE PRIMARY NaK LOOP VALVE SETS. Folder 3. A Supplement to Folder 1 (Technical Proposal). (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Jul 1969. 22p. Dep. NTIS $4.25.

A design proposal for a flapper type check valve for service in the primary loop of a NaK cooled space power reactor is presented. (JWR)

2490 (TID/SNA-571) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE INLET LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

Part I of two parts.

2491 (TID/SNA-1390) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 AUGUST 1963–26 SEPTEMBER 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Oct 1963. 257p. Dep. NTIS $16.00.

Progress in engineering, fabrication and testing of reactor components is summarized. Schedules are submitted for all subtasks. (LTN)

2492 (TID/SNA-1397) ASTR-4 IRRADIATION TEST, PRELIMINARY REPORT. Laney, W. M.; Guinn, J. W. (General Dynamics/Fort Worth, Tex. (USA)). 4 May 1964. 68p. Dep. NTIS $6.50.

A radiation effects test of turbopump bearings installed in a motor-driven tester with liquid hydrogen flowing through it is described. The bearing tester was operated for more than 300 seconds with the ASTR reactor at 10 megawatts. It was then shipped to Aerojet-General Corp. for analysis. (LTN)

2493 (TID/SNA-1443) NRX-A ALUMINUM PRESSURE VESSEL, S/N 0000002, HYDROSTATIC TEST STRUCTURAL EVALUATION REPORT. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Oct 1963. 209p. Dep. NTIS $13.50.

Declassified 18 May 1965.

The hydrostatic proof test of the NRX-A aluminum pressure vessel, also known as Pressure Vessel Structural Test No. 2, was conducted in the Structural Test Laboratory, Solid Rocket Plant, Aerojet-General Corporation, Sacramento, California from 21 May 1963 to 21 June 1963. The test was successful in (1) demonstrating the ability of the pressure vessel to withstand a room temperature proof pressure of 645 psig, (2) providing information on flange deflections and rotations and stresses in areas computed to have minimum margins of safety, and (3) demonstrating the ability of the structural nozzle simulator, to withstand a proof pressure of 485 psig. Experimental analysis revealed there was no yielding of the test assembly. (auth)

2494 (TID/SNA-1471) PRELIMINARY REPORT ON THE NERVA SYSTEMS ANALYSIS PROGRAM UNDER SUB TASK 1.1.6. McFarland, B. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Apr 1963. 37p. Dep. NTIS $5.00.

The systems analysis programs at Aerojet are described from the performance evaluation and data analysis viewpoints and related to the goal of a balanced development program. Plans are being made to handle the large volume of test data expected and to coordinate systems analysis work of the companies involved. Systems analysis should be a design aid, provide criteria and constraint information for both design and testing, and provide analytical services for the coordination of component development, engine integration and evaluation and analysis of performance. (LTN)

2495 (TID/SNA-1476(Vol. 2)(Pt. 1-A)) VOLUME II. Program Plan. Part I-A. Technical Administration Documents. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Nov 1962. 73p. Dep. NTIS $6.75.

2496 (TID/SNA-1504) ENGINE SYSTEM STEADY STATE ANALYTICAL PROGRAM, REV. 2.0, FOR HEATED AND HOT BLEED CYCLES (IBM 7094 DIGITAL COMPUTER, FORTRAN SYSTEM). Volume I. VisGirda, T. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 May 1963. 272p. Dep. NTIS $16.75.

A set of equations representing both heated and hot bleed cycles of the steady state Nerva engine system have been programmed for solution on the 7094 IBM digital computer. The equations, representing an analytical engine model, include propellant feed system, thrust chamber, cooling jacket, simplified reactor-reflector system, mixing chamber, tank pressurization system, turbine and turbine exhaust system. Arbitrary input data have been used for solution of thermodynamic and nuclear problems for a few undefined bulk regions of the reactor-reflector system. The multicomponent thermodynamic properties of the working fluid, as a function of temperature and pressure, are computed at various points in the engine system. Pressure drops of engine thermodynamic processes, and means for controlling pressure in the thrust chamber and at the turbine inlet are included. Heat transfer in the thrust chamber cooling jacket and in the reactor-reflector system are accounted for, and means of controlling a given reactor power level, thrust chamber temperature and overall engine heat balance are included. Energy and mass balances are computed by the standard thermodynamic equations for one-dimensional, steady and continuous flow process. The system equations provide necessary data for analysis of engine performance for a balanced engine system. The primary purpose of such a program is to evaluate the off-design performance of the engine. Functional relationship of engine parameters to various components of the engine and analysis of such parameters permits development of criteria for engine optimization. The program should be expanded to include the analytical solution of special problems such as radiation heating, shield neutronics, heat of propellant dissociation and other related problems of thermo-nuclear phenomena. The simulation of the true engine will also require more detailed design information and definition of some regions of different constituency from those of a simplified engine model. (auth)

2497 (TID/SNA-1541) SUMMARY OF RESULTS, EFFLUENT MONITORING PHOEBUS IB EP-IV. Van Vleck, L. D. (Pan American World Airways, Inc., Las Vegas, Nev.). 19 Jul 1967. 58p. Dep. NTIS $6.00.

Emphasis for data collection during the Phoebus IB full power run was placed on the collection and analysis of ground-deposited radioactive particulates. Detailed particle collection and particle deposition measurements were performed at 2.5, 5, 15, and 25 miles. Partial coverage of the 12-mile arc was accomplished, and one positive area at a distance of 45 miles downwind was surveyed and sampled. The particles found at all distances were irregular in shape with only a few spherical ones located. Particles are generally fragile, and many were smashed during handling. There was at least one location within the cloud at every sample distance downwind where the particle concentration was sufficiently high to equal a probability of one that a man under the cloud would be hit by a particle. Ensemble averaging over all particles from all distances (which approximates the source term distribution) establishes a count median diameter of 67 microns with a geometric mean deviation of 2.0. The mean particle size falls off approximately as the square root of the distance. Similarly, the mean radioactivity per particle, expressed as number of fissions, falls off regularly with distance. The count median particle activity, determined by averaging all particles from all distances, is 5×10^9 fissions, with a geometric mean deviation of a factor of 10. No reliable relationship exists between particle size and activity per particle. For a given activity the particle size range amounts to a factor of eight. Given the particle size, the activity range is more than four decades. Crude estimates of the particle density for 15 particles give an average value of 5.6 gms/cm^3. The average of 22 particle weight determinations was 7.8 micrograms. The median weight is 5.2 micrograms. A total of 2.5×10^6 particles can be accounted for from ground deposition measurements made between the distances of 2.5-25 miles. Particle activities were converted to contact beta dose rates using data presented by United States Naval Radiological Defense Laboratory (USNRDL) in their document, number TR1082. Assuming that a dose of 2000 rads to a limited area of the skin will prove to be an acceptable dose, it appears that for average particle activities this dose will not be exceeded beyond 15 miles. However, for extremely high particle activity this dose would not be exceeded beyond distances of 30 or 35 miles. (auth)

2498 (TID/SNA-1555) INPUT TO NRDS EFFLUENT DATA BANK. NERVA Technology Program. Fesmire, V. R. (comp.). (NERVA Test Operations, Jackass Flats, Nev. (USA)). 23 Jan 1970. 38p. Dep. NTIS $5.00.

Data on the effluent generation, release, transport, and the potential and absorbed doses from the testing of the NRX and XE reactors is presented. (JWR)

2499 (TID/SNA-1560) NRDS PROGRAM REQUIREMENTS HANDBOOK. (USAEC/NASA Space Nuclear Propulsion Office, Jackass Flats, Nev. (USA)). 21 Feb 1963. 60p. Dep. NTIS $6.00.

This Program Requirements Handbook (PRH) is the basic document governing the conduct of technical operations at the Nuclear Rocket Development Station (NRDS). It provides the guidelines governing the preparation of the documentation necessary to assure and provide the many goods and services necessary in the conduct of Rover testing of reactors, engines and stages at NRDS. The handbook sets forth the requirements for the rendering of information governing support to be provided at NRDS beginning with the activation of test facilities on through any and all tests conducted in those facilities. (auth)

2500 (TID/SNA-1585) PROGRAM PLAN. Part I. Technical Administration Documents. Volume II. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Nov 1962. 106p. Dep. NTIS $8.50.

Research programs for contract year 1963 are described in detail. (LTN)

2501 (TID/SNA-1589) SNP-1SA3, CONTRACT MONTHLY LETTER REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1963. 122p. Dep. NTIS $9.25.

Design and fabrication progress on the Cold Flow Development Test System (CFDTS) and the NRX-A1 reactor are reported. Design, fabrication or procurement, and testing of many other reactor components are listed. Fugure planned effort is described briefly. (LTN)

2502 (TID/SNA-1614) NERVA TECHNICAL ADMINISTRATION DOCUMENTS: ALL SUBTASKS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 16 Dec 1963. 108p. Dep. NTIS $8.50.

The development programs for contract year 1964 are defined by task and subtask, sometimes in considerable detail. This is a management type report providing a detailed contractual basis that the company and the government contracting office agreed to as of the date of issue. (LTN)

2503 (TID/SNA-1615) NCS 306 NERVA TECHNICAL DISCUSSION, SUBTASK ITEM 2.4, CONTRACT YEAR 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Aug 1963. 80p. Dep. NTIS $7.00.

The planned work on instrumentation development is outlined, including selection, testing, radiation effects, data acquisition systems, etc. In some cases, the instrumental requirements are given in detail so instruments can be developed to fill the need; in others, the environment in which the instruments are to operate is described as a critical factor. (LTN)

2504 (TID/SNA-1620) ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS. Annual Progress Report. (NUS Corp., Washington, D. C. (USA)). Jun 1964. 235p. Dep. NTIS $14.75.

Major efforts at NUS directed toward refinement of the earlier analysis (presented in NUS-122) of the environmental safety aspects of nuclear rocket flight operations are described. This refinement has been characterized by two factors: first, the incorporation of the most recent data available from programs within and without the ROVER program; second the programming of the hazard analysis for IBM 7090/7094 computation. An initial attempt was made to categorize and summarize those studies conducted inside and outside the program which would contribute to knowledge of the safety aspects of NERVA/RIFT. (auth)

2505 (TID/SNA-1625) NUCLEAR HEATING EFFECTS IN PROPELLANT IN CLUSTERED PAIRS OF NUCLEAR STAGES. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). Sep 1964. 32p. Dep. NTIS $4.75.

Preliminary analyses have been performed to determine the effect of nuclear heating in the LH_2 propellant on boil-off weight and resulting payload decrement, and propellant temperature rise in pairs of clustered nuclear stages. Two nuclear stage configurations were studied; propellant tank capacities of 180,000 pounds and 340,000 with 2000 and 5000 mw engines, respectively. The study showed that differences in nuclear heating of the propellant between single and clustered stages does not impose large payload decrements for either size engine. Payload differences of 1000 lb and 1600 lb were found for the 2000 mw and 5000 mw engines, respectively. Recommended future work includes extending this preliminary study to permit proper recognition of the thermal behavior of the propellant during the boost and early orbit phases of flight; conducting more thorough studies of clusters of three, four, and five stages for a wider range of engine power levels and shield weights; modification of the LMSC Propellant Flow Model to accommodate the anisotropic nuclear heat generation characteristics of clustered stages; and conduct of simple tests to confirm the predicted behavior of liquids when heated in an anisotropic thermal environment. (auth)

2506 (TID/SNA-1631) NUCLEAR ROCKET SYSTEMS FOR RAPID MANEUVERS OF MILITARY SPACE SYSTEMS. Grey, J. 30 Apr 1962. 39p. Dep. NTIS $5.00.

For Aerojet-General Corp., Azusa, CA.

Arguments for the use of nuclear rockets in high-acceleration maneuvers in space are presented. Several representative missions of this type are selected as examples, and it is concluded on the basis of some simple calculations that nuclear propulsion systems are well suited to this class of mission. Gross weights of the nuclear-powered maneuvering vehicles become smaller than those of chemical-powered systems as the required amount of maneuvering increases, and for high degrees of maneuverability are unquestionably superior on any basis of comparison. Of the various nuclear systems considered, the small, fast reactor concepts appear most generally suitable. The higher-performance systems such as low-pressure nuclear rockets or heat-addition nozzles, although providing excellent payload capability, suffer seriously from a number of other factors. (auth)

2507 (TID/SNA-1637) GRAPHITE INTERFACE STUDIES. Technical Summary Report, May 16, 1963–May 15, 1964. Bardes, R.; Neill, J.; Young, J. A. (General Atomic Co., San Diego, Calif. (USA)). 15 May 1964. Contract AT(04-3)-167. 99p. Dep. NTIS $8.00.

A series of experiments to determine the graphite thermalization in the reflector of a KIWI type reactor are described. (JWR)

2508 (TID/SNA-1639) AMF RELATED EXPERIENCE FOR PROJECT NERVA. (AMF Atomics, Greenwich, Conn. (USA)). Mar 1961. 121p. Dep. NTIS $9.25.

2509 (TID/SNA-1655) DEVELOPMENT OF FABRICATION TECHNIQUES FOR CONSTRUCTION OF NERVA TITANIUM PRESSURE VESSEL. Bateman, R. G. (Marquardt Corp., Ogden, Utah (USA)). 9 Aug 1963. 39p. Dep. NTIS $5.00.

For Aerojet-General Corp.

The titanium rocket motor case fabrication and the associated test program which was conducted to evaluate techniques and mechanical properties are summarized. Early in the pre-fabrication discussions it was decided that a test program was necessary so test rings approximately 2.50 inches wide and 49.180 inches O.D. were joined to: Provide test material of weldments for room temperature and cryogenic temperature in both the notched and unnotched conditions; evaluate weld rod filler metals compatible with the 5A1-2.5 SN extra low interstitial titanium forgings developed for the case and closures; provide machine settings and weld schedules for automatic tungsten inert gas (T.I.G.) welding, and the tooling developed for the full scale case weldments; and provide welded rings to tool prove the technique of hot sizing accomplished by differential expansion between the low expansion titanium material and a high expansion stainless steel mandrel. The test ring program provided the necessary data for the final fabrication of the rocket case. Certain problem areas were discovered and corrected before the actual fullscale hardware was fabricated. Consequently, the full scale motor case was completed with little difficulty at the termination of the test ring program. Test rings which cracked or fractured during the hot sizing operations failed because of high residual stresses from the weldments, accentuated during the hot sizing operation and possible chlorine contamination of the tools and ring details during fabrication. The hot sizing method for holding precision dimension is entirely practical, but must be controlled carefully. With titanium alloys one must avoid during the pre-sizing operations any contamination by chlorine compounds and residuals from handling before and during sizing. (auth)

2510 (TID/SNA-1662) NRX-A1 INSTRUMENTATION DISCREPANCIES FOR EP-I AND EP-II. Loy, H. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Apr 1964. 24p. Dep. NTIS $4.25.

Methods of correcting erroneous data from a small number of NRX-A1 instrumentation channels to obtain the true values are given, i.e., these data contained correctable discrepancies. (LTN)

2511 (TID/SNA-1663) NRX HAZARDS SUMMARY REPORT. Chapter 5. Test Cell and Control Point. (Los Alamos Scientific Lab., N. Mex. (USA)). 1962. 72p. Dep. NTIS $6.75.

The hazards associated with test cell A operations are reviewed. These consist mostly of high pressure gas systems (nitrogen, hydrogen, helium), liquid hydrogen systems and radioactivity from testing operations. (LTN)

2512 (TID/SNA-1666) TECHNICAL ADMINISTRATION DOCUMENTS. NCS-305 Volume I, Part III. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Mar 1963. 145p. Dep. NTIS $10.25.

NERVA work programs covering engine system development, propellant feed system, thrust chamber assembly, engine controls, pneumatic systems, radiation effects, remote handling system, instrumentation, testing, and management are presented. (JWR)

2513 (TID/SNA-1667) TECHNICAL DISCUSSIONS, NCS-305 Volume I, Appendix. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Mar 1963. 148p. Dep. NTIS $10.50.

Planned research and development programs for NERVA in the contract year 1963 are described in detail. (LTN)

2514 (TID/SNA-1674) IRRADIATION TEST No. ASTR-4A PRELIMINARY REPORT. Guinn, J. W.; Pou, C. G. (General Dynamics/Fort Worth, Tex. (USA)). 2 Nov 1964. 86p. Dep. NTIS $7.50.

Candidate turbopump bearings for the NERVA engine were irradiated in the ASTR reactor for 1 hour at 10 Mw power, while operating in a motor-driven tester with liquid hydrogen flowing through the bearings. The tester was shipped to Aerojet General Corp. for post test analysis. Dosimetry was incomplete for this preliminary report. (LTN)

2515 (TID/SNA-1709) NERVA THRUST STRUCTURES. Component Design Report (Interim). Bronner, H. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1971. 249p. Dep. NTIS $15.50.

The design of the thrust train for the NERVA Engine is governed by structural and functional requirements as well as physical interactions from neighboring components. The thrust train must transmit engine thrust force to the flight vehicle, provide a means for command adjustment of thrust vector (that is, contain a hinge joint), provide a single plane

interface with the flight vehicle for mechanical, fluid, and electrical connections, and fit the prescribed dimensional envelope dictated by specific design features of the engine. The thrust structure design to meet the requirements imposed upon the thrust train contains two elements; an upper thrust structure, and a lower thrust structure. The upper thrust structure is a device which interfaces with the vehicle thrust frame on its upper face and with the engine gimbal pivot on its aft face. At the vehicle interface are assorted electrical and fluid remote couplings as well as remote mechanical connections for in-flight replacement of the engine assembly. Fundamentally, the upper thrust structure is an arrangement of girders within a circular box beam constructed entirely of aluminum sheet, extrusions, and forgings. The lower thrust structure interfaces functionally with the upper thrust structure thru the gimbal pivot to form the thrust train from the thrust chamber (pressure vessel and nozzle containing the nuclear reactor) to the flight vehicle. The lower thrust structure serves as a mount for the bulk of propellant feed system components, as well as a mount for a nuclear radiation shield for manned flight applications. The fundamentals of the design of the lower thrust structure are a cylindrical thin-walled column which transmits engine thrust to the gimbal pivot through a conical transition section with a crossed truss interface with the gimbal pivot. Attached to the surface of the structure are assorted mounting pads and framework for the propellant feed system components and radiation shield. Design studies of the thrust structure for the NERVA engine have produced upper thrust structure and lower thrust structure concept designs which represent logical, but not completely optimized, approaches to fulfillment of the design objectives. Most of the referenced reports are attached. (auth)

2516 (TID/SNA-1711) ENGINEERING OPERATIONS REPORT: NERVA NOZZLE FORGING DEVELOPMENT (ARMCO 22-13-5) REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 10 Apr 1972. 53p. Dep. NTIS $5.75.

A large scale forging fabrication and materials development program was conducted to determine if Armco 22-13-5 could be forged in large sections to acceptable quality levels and to determine the tensile properties and chemistry of the final product. To achieve the highest quality and minimize variations between forgings it was decided to use a closed die-press, forging operation at Wyman–Gordon. Tooling costs were reduced to practically zero by using residual Rocketdyne Technology nozzle tooling. Initial attempts to produce 17½" billets from vacuum arc remelt material were unsuccessful because of nitrogen volatization and arc instability problems. Electro slag remelt was then tried and this was successful. Three ESR billets were produced with only one 5/64 ultrasonic indication. These 17½" ESR billets were used to produce 3 Armco 22-13-5 nozzle convergent section forgings, which were subsequently machined to ANSC P/N 1139307. The final forgings were ultrasonically and penetrant inspected with no defects indicated. The resulting tensile properties were above specification minimum, and within chemistry tolerances. The NERVA program now has a developed stainless steel with excellent ductility which is approximately double the yield strength of 300 series stainless steels. It is recommended that this alloy be used for future NERVA nozzle jacket and considered for many other applications. It is also recommended that the forging be sectioned and tested to establish design minimum tensile properties. (auth)

2517 (TID/SNA-1712) GIMBAL PIVOT ASSEMBLY. Component Design Report (Interim). Bronner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 71p. Dep. NTIS $6.75.

The concept design and analysis for the gimbal pivot assembly of the 75K NERVA Engine are documented. The primary objective was to examine the effect of materials properties on the size and stiffness of the gimbal pivot assembly. The specific effect of Young's modulus and material strength is discussed. The nuclear, thermal, stress, weight, and dynamic analyses made for the gimbal pivot assembly as a unit or as a part of the engine assembly are referenced and/or discussed. Finally, fabrication methods are discussed briefly. The level of maturity of the design studies presented does not provide a sufficiently sound basis for preliminary design of this component. It does, however, provide sufficient evidence to proceed with development of the analytical justification of the gimbal pivot concept described. (auth)

2518 (TID/SNA-1714) MAINTAINABLE ELECTRONIC MODULE UTILIZING REPLACEABLE ELECTRICAL SPRING CONTACTS. Yoder, S. K. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Apr 1971. 36p. Dep. NTIS $5.00.

The general description of the Maintainable Electronic Module is contained in Disclosure of Invention documents which are attached for convenience. A wide range of latitude in the configuration of the Maintainable Module is obviously possible depending on the detail requirements. However there are features that are necessary to all solutions involving the use of maintainable spring contacts which include: insuring electrical contact resistance within the limits established by circuit functions and by circuit noise limits, and insuring spring stresses within the limits necessary to satisfy spring life/reliability requirements. (auth)

2519 (TID/SNA-1718) VIEWGRAPHS, MASTER VELLUM FILE. Book 2. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 397p. Dep. NTIS $23.00.

A master vellum file of several hundred viewgraphs of NERVA designs and progress has been documented. (LTN)

2520 (TID/SNA-1726) NOZZLE ASSEMBLY TRADE STUDY. Bleed Cycle Engine Presentation. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 95p. Dep. NTIS $7.75.

Material presented at a review of a nozzle assembly trade study of the NERVA hot bleed cycle engine has been documented. (LTN)

2521 (TID/SNA-1745) ENGINEERING OPERATIONS REPORT: 1137400E NERVA ENGINE OPERATING DESCRIPTION. Conn, K. R.; Houghton, W. J.; Pasternak, T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 25 Oct 1971. 26p. Dep. NTIS $4.25.

The principal changes from the previous description are in the sections on engine conditioning, tailoff, and cooldown. The goal of the write-up is to give the current best estimate of how the operation of the 400E engine can be made feasible and as close to optimum with present knowledge. This operating description is different from the last one, published in N4110:2043 on 23 Dec 1970, in four major ways: (1) chilldown includes a period of low propellant flow (about .02 lb/sec) under tank pressure for about an hour or more, (2) dual pump feed system stability is maintained during bootstrap and tail-off by bypassing propellant back to the tank through the cooldown line, (3) turbopumps are repetitively restarted during cooldown to supply flow pulses to avoid core over-heating from laminar flow instability, and (4) the reactor is brought critical and operated at low power levels a few times during cooldown to achieve impulse controllability. (auth)

2522 (TID/SNA-1774) ENGINEERING OPERATIONS REPORT: TURBOPUMP RELIABILITY BLOCK DIAGRAM AND FAILURE MECHANISM DEFINITION. Bair, E. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Feb 1972. 42p. Dep. NTIS $5.25.

A reliability block diagram for the turbopump was developed which relates the engine failure modes to failure mechanisms, which are subsequently broken down to a part/mechanism relationship that is amenable to probabilistic analysis. The NERVA Engine Reliability allocations identify six failure modes which are applicable to the turbopump: Failure to Start, Low Performance, Premature Stop, Loss of Containment, Excessive Vibration, and External Leakage. These failure modes were used to generate a turbopump (TPA) reliability block diagram which was then broken down, in steps, until part/mechanism relationships were established which are amenable to probabilistic analysis. Upon completion of the probabilistic analysis, for each part/mechanism relationship, the reliability values may be examined (probably a product relationship) to determine if the overall turbopump and the failure mode reliability allocations are satisfied. Prior to completion of all of the models, the block diagram may be used as a device for allocating reliability requirements down to the part/mechanism relationship. This is done simply by first defining the failure mode reliability value, then summing the total number (n) of part/mechanism relationship for that mode and then taking the failure mode reliability allocation to the n th root. In other words: Part/Mechanism Allocation = (Failure Mode Allocation)$^{1/n}$. The complete listing of part/mechanism relationships, including any applicable intermediate considerations, is presented. (auth)

2523 (TID/SNA-2201) ENGINEERING OPERATIONS REPORT: NERVA COOLDOWN GUIDANCE. Carlson, G. A.; Siebenhaar, A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1972. 25p. Dep. NTIS $4.25.

A guidance system has been devised which is capable of handling the thrust characteristics of a nuclear powered space vehicle during the reactor cooldown phase. The procedure for obtaining optimal performance has been outlined in terms of known mathematical techniques. A convenient method of predicting the engine performance based on a continually improving model has been presented along with an algorithm to determine the required corrective actions needed to achieve the terminal conditions. Preliminary studies of portions of the guidance system described have indicated that the methods are feasible and should work successfully. The computer run time and storage

requirements are reasonable. The method is flexible enough to handle any anticipated nuclear rocket engine designs in the foreseeable future. (auth)

2524 (TID/SNA-2204) ENGINEERING OPERATIONS REPORT: STATUS REPORT ON HYDROGEN SPECIE IN THE NERVA ENGINE DESIGN. Buden, D. (Aerojet-General Corp., Sacramento, Calif. (USA)) Nov 1971. 73p. Dep. NTIS $6.75.

A review of the available information on possible specie conversion occurring within the NERVA engine indicates that the current design procedure is conservative. All indications from previous test articles, including Pewee, NRX, XE and Phoebus test systems, indicate that though the specie is not definitely known, the articles behaved in a predictable manner. Since NERVA is of a size 40% larger than XE in power but ⅓ the power of Phoebus and of the same basic design, it is reasonable to anticipate similar system performance. In addition, added conservatism is provided in the design by incorporating an additional 2.2% bypass allowance to account for additional changes in hydrogen specie. This 2.2% is based upon the avalanche theory of all conversion at the turbine inlet but that otherwise the mathematical models from the technology program are good. (auth)

2525 (TID/SNA-2207) ENGINEERING OPERATIONS REPORT: TPA EQUATIONS AND LOGIC USED IN SYSTEM DIGITAL CODES. Madsen, W. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1971. 17p. Dep. NTIS $4.00.

The logic, equations, and inputs which describe the TPA in the systems analysis digital computer codes are documented. Included are both the current method and equation set used in NETAP and CDM as well as a revised equation set and logic for the turbine that will be used in the future. These new turbine equations require only a slight modification to the current CDM computer code, and will bring it in line with the revised form of TPA data now being generated by the TPA section. It should be noted that all the TPA data stored in the program is in three-dimensional tables; however, in some cases, only two dimensions are required. The turbopump is mathematically modeled using a pump work equation, a turbine work equation, and the energy balance on the turbopump assembly. (auth)

2526 (TID/SNM-13) AGC DUAL MODE PUMP TESTS. Experimental Plan III. (Los Alamos Scientific Lab., N. Mex. (USA)). 19 Mar 1970. 54p. Dep. NTIS $5.75.

The objectives of this NERVA experimental plan were: (1) To investigate the system startup with one chilled pump and one partially chilled pump. (2) To investigate the dual mode system performance with unbalanced pump inlet pressures. (3) To investigate the dual mode system performance with unbalanced turbine inlet pressures. (auth)

2527 (WANL-TME-206) PRELIMINARY RESULTS OF EXPERIMENTS 6 THROUGH 10 CONDUCTED AT THE WESTERN NEW YORK NUCLEAR RESEARCH CENTER REACTOR DURING THE TIME PERIOD OCTOBER 29–NOVEMBER 2, 1962. Kalapaca, H. P. (comp. and ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Nov 1962. 7p. Dep. NTIS $4.00.

Preliminary results of irradiations of electronic equipment in the Western New York Nuclear Research Center are given. Radiation-induced currents were recorded in coaxial cables during irradiation, but not in cables heated to the same temperature in an oven. Radiation-induced noise in the cables was not serious. Irradiated electronic tubes exhibited some changes in characteristics. Micafilled silicon resin coatings on electronic circuitry had somewhat less change in insulation resistance than uncoated circuits or those coated with glyptal or unfilled resin. All samples recovered their insulation resistance after the irradiation. Little change was noted in other electronic equipment irradiated in this experiment. (LTN)

2528 (WANL-TME-251) GETR DATA PACKAGE. Coombe, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Sep 1962. 26p. Dep. NTIS $4.50.

Considerable information was provided in order to satisfy requirements for an irradiation test on bearing components carried out in the GETR reactor. The samples contained molybdenum and/or tungsten selenide, copper or bronze or silver, and teflon or poly-imide. The calculated activation products were mostly radionuclides of tungsten and copper (700 to 5700 Curies). This radiation was calculated to be sufficient that the return shipment of the irradiated material might have to be delayed until applicable shipping regulations were satisfied with the cash available. Radiation heating, heat transfer and thermal stresses were calculated in specimens and capsule material. (LTN)

2529 (WANL-TME-267(Rev.C)) WANEF OPERATIONS MANUAL. Frantz, F. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 30p. Dep. NTIS $4.50.

This manual contains the WANEF administrative controls, personnel responsibilities, and operating procedures. Also included are brief descriptions of the facility and its control and safety systems. (auth)

2530 (WANL-TME-362) AUTOMATIC NEUTRONICS CALIBRATION. Kendziorek, W. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Jan 1963. 6p. Dep. NTIS $4.00.

A need exists for a more precise measurement of reactor power level than is now possible using neutron detectors. This need becomes particularly evident when one considers that the trip settings of power level cutbacks and scrams must be adjusted to be greater than the maximum normal power by at least the expected measurement error in order to avoid false scrams. This report describes some present practices in regard to power calibration techniques and goes on to propose an automatic calibrator based on thermal power. A workable power calibrator has been constructed which is capable of producing a signal proportional to true power. The accuracy of such a system is limited primarily by the accuracy of the chamber temperature and the mass flow rate signals. The total system error, however, should be considerably less than ±10% of full power. This is at least three times better than conventional nuclear instruments. (auth)

2531 (WANL-TME-393) NRX CONTROL LOOP INTERFACE. Morris, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Jun 1963. 7p. Dep. NTIS $4.00.

Agreements among the 4 companies involved on interface connections between instrumentation on NRX-A1 and Test Cell "A" controls are reviewed. Usually, the company supplying the particular instrument was supposed to provide wiring to the first termination at the Test Car Privy. Signal conditioning equipment was to be supplied as part of Test Cell "A". Some problems remain in the method of attaching the wiring boom to the pressure vessel, mainly how to prevent cable damage or noise due to relative motion. (LTN)

2532 (WANL-TME-575) EVALUATION OF THE MEAN SQUARE NEUTRON DETECTOR SYSTEM FOR NERVA USE. Austin, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Oct 1963. 25p. Dep. NTIS $4.25.

Declassified 22 Sep 1964.

In May 1963, the General Electric Corporation presented to WANL an unsolicited proposal to develop a one-detector, wide-range, neutron flux measurement system for possible application in control use of NERVA. The Space Nuclear Propulsion Office, Cleveland, Ohio, and REON, Aerojet Corporation, requested WANL to analyze this proposal. This is an evaluation of the system for NERVA application. The proposed mean square detection system is a unique and new method of determining neutron fluxes in the presence of gamma radiation. The method should find wide application in industry, science and certain space nuclear applications. The system may not be used in the control of NERVA, as a one detector system, because: A gap is present between the two modes of operation, and the system would not be responsive for several hours after a run at power. The proposed system has stringent limitations in flux magnitudes required for dependable operation, and is not versatile enough for anticipated differences from calculated values. (auth)

2533 (WANL-TME-609) CONTROL DRUM BEARINGS, EXPERIMENT NO. 40/W004, IRRADIATED AT PLUM BROOK REACTOR FACILITY, PBRF CYCLE 6 (PB NO. 2W). Preliminary Data Report. Stephens, A. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Feb 1964. 9p. Dep. NTIS $4.00.

The control drum bearings were irradiated in a static test in the W-2 facility of the Plum Brook Reactor and at a power level of approximately 40 MW. The sample fixture containing the bearings was exposed to an average water temperature of 118°F and an average pressure of 130 psig. The fixture was irradiated for 3.58 hours at an average reactor power of 34.14 MW, acquiring an exposure of 122.31 MW-hr. Two control drum bearings and an additional retainer ring to be irradiated were housed in a sample fixture. The bearings were modified Marlin Rockwell Corp. products, size 206S. The inner and outer races and the balls were constructed of a stainless steel containing 14 percent chromium and 4 percent molybdenum. The retainer rings were constructed from a material containing 40 percent bronze, 40 percent polyimide; and, in one case, 20 percent tungsten diselenide, and in the other case, 20 percent molybdenum diselenide. (The extra retainer ring also contained the tungsten diselenide.)

Results of the post-irradiation examination will be detailed in the Test Report. (auth)

2534 (WANL-TME-621(Rev.900-1)) NUCLEAR SAFETY MANUAL. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 160p. Dep. NTIS $11.00.

Criticality control measures in the fabrication, inspection, storage and transport of nuclear fuels are defined. Special attention is given to residues, waste material, etc. Provisions are made for approved criticality zones and limits on the amount of material in racks and in zones, or in various processes. Detailed instructions are given for many operations. (LTN)

2535 (WANL-TME-699) PRELIMINARY DATA REPORT: LINEAR DISPLACEMENT TRANSDUCERS, EXPERIMENT NO. 23/W202, IRRADIATED AT PLUM BROOK REACTOR FACILITY, PBRF CYCLE 6 (PB NO. 3W). Stephens, A. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Mar 1964. 35p. Dep. NTIS $4.75.

Eight linear displacement transducers were irradiated and tested in the W-2 facility of the Plum Brook Reactor at a power level of approximately 50 Mw. The transducers were dynamically tested only up to 10 Mw, since the transducer fixture became inoperative when the reactor reached 10 Mw. The fixture was irradiated for about 99 hours at an average reactor power of 42.3 Mw, acquiring an exposure of 4192 Mw-hr. Raw data involving output voltages, insulation resistances, and winding resistances, before and during irradiation, are given without further evaluation. Two transducers became inoperative. (auth)

2536 (WANL-TME-978) PRELIMINARY STUDY OF THE NERVA II REACTOR DESIGN. Black, D. L.; Cooper, L. H.; Dickson, P. W.; Stefanko, J. S.; Kim, C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1964. 160p. Dep. NTIS $11.00.

Declassified 30 Aug 1973.

In May, SNPO initiated Project NE 1840 at the Astronuclear Laboratory to examine the feasibility of adapting the PHOEBUS and NERVA technology to the design of a flight rated reactor of 5000 MW power capability. Simultaneously, an effort was initiated at the Aerojet-General Corporation evaluating feasibility of an engine, the NERVA II, based on this reactor. In the limited time available, no attempt was made to develop an optimized design for such a reactor, but rather, a reasonable configuration was selected and its feasibility was demonstrated within the framework of modest extrapolations from NRX-A technology. In developing this reactor configuration, the following ground rules were used: Provision of a reactivity control span comparable to that of NRX-A (~$8.70); use of the fuel element fabrication technology developed for the present KIWI and NRX-A reactors; and provision of the maximum fuel volume consistent with ground rules 1 and 2, so that increases in power density can be held to reasonable extrapolations of NRX-A. The bases of the selection of this NERVA II reactor configuration are described, and provide a more detailed description of its characteristics. As stated previously, the reactor should not be considered an optimum configuration. Work to evolve alternate designs, to evaluate them, and to select a conceptual design will be continued. (auth)

2537 (WANL-TME-997) REACTOR EXPERIMENTATION AND THE PACKARD-BELL COMPUTER. Beene, J. L.; Rankin, W. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1964. 126p. Dep. NTIS $9.50.

The primary purpose of this report is to provide general knowledge for computer applications to nuclear problems. For the nuclear engineer, it should provide some ideas for increased data acquisition, reactor monitoring and general reactor experimentation, and for the computer applications engineer and programmers, the programs may provide some clever techniques to problem solutions. Even some needed basic subroutines are included to add to general field requirements. The Westinghouse Astronuclear Experimental Facility (WANEF) is the critical experiments unit of Astronuclear, located at the Waltz Mill Site in Pennsylvania, whose task it is to perform basic research and reactor analysis on the NRX series of nuclear reactors to be used in America's first nuclear rocket engine. As examples, some of the solutions to problems of reactor analysis using a small general purpose computer are given. While most of the programs discussed are probably quite unique to WANEF, the reader may find an insight to his own specific problems. (auth)

2538 (WANL-TME-1319) FAILURE MODE ANALYSIS OF THE TE MODULE REFERENCE DRAWING 909E680. Ottenheimer, F.; Wagner, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Nov 1965. 16p. Dep. NTIS $4.00.

A detailed Failure Mode Analysis of the Thermoelectric Module, based on the drawing referenced, has been performed and is presented in the following pages. This effort is to be used as guidance in test planning and future design modifications. Recommendations for means of minimizing or eliminating failure modes are given with each detail review. (auth)

2539 (WANL-TME-1320) NRX/EST OPERATING LIMITS DOCUMENT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1965. 21p. Dep. NTIS $4.25.

2540 (WANL-TME-1323) STRESS ANALYSIS: TEM-1 THERMOELECTRIC MODULE. Caputo, R.; Soo, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1965. 35p. Dep. NTIS $4.75.

This report contains the stress analysis of the TEM-1 module for its fabrication processes and operating condition. A three layer instead of the actual seven layer model is used in all the calculations. For the swaging operation, a digital computer code was used to find a closed-form solution of the stresses and deformations. A simplified method including stress relaxation effect was used to analyze the autoclave process and operation condition. The final results of this calculation indicate that the radial contact pressure at initial steady state operating temperature is about 6000 psi. After 10,000 hours operation, the remaining pressure is roughly estimated at 4000 psi which is sufficient for good contact at the interfaces. (auth)

2541 (WANL-TME-1380) DATA REPORT: STRUCTURAL MATERIALS EXPERIMENT 37/LA001 IRRADIATED AT PLUM BROOK REACTOR FACILITY, PBRF CYCLE 42. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 39p. Dep. NTIS $5.00.

Structural materials being evaluated for potential use in the PHOEBUS reactor were irradiated in HT-1 of the Plumbrook reactor facility (Exp. 37/LA001, PBRF Cycle 42). There were 19 brazed tensile specimens, 15 brazed shear specimens (inconel 718, 7039-T61 aluminum and 347 stainless steel) and 2 graphite specimens for post-irradiation thermal conductivity measurements. The test fixture was irradiated in HT-1 for 10 days and the specimens sent to LASL for post-irradiation examination. (LTN)

2542 (WANL-TME-1383) NRX-A5 OPERATING LIMITS DOCUMENT. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Mar 1966. 19p. Dep. NTIS $4.00.

2543 (WANL-TME-1405) NERVA HIGH TEMPERATURE THERMOCOUPLE INSULATOR DEVELOPMENT. Dunn, W. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 22p. Dep. NTIS $4.25.

Progress on the evaluation of refractory insulators for high temperature thermocouple applications is described. Earlier work is reported in WANL-TME-1279 (CRD). This study is being conducted for the purpose of improving accuracy in the measurement of NERVA core temperatures. Errors result from insufficient electrical resistance in thermocouple insulators. At present the materials beryllium oxide (BeO), hafnium oxide (HfO_2), thorium oxide (ThO_2), and magnesium oxide (MgO) have been evaluated as high temperature thermocouple insulators. It was learned that the electrical resistivity of BeO was permanently improved after a temperature cycle to 4000°R. Also, it was learned BeO was the best of the four sample insulators followed by hafnia (HfO_2) down by a factor of 10, then thoria (ThO_2) down by a factor of 20. Although magnesia (MgO) demonstrated good electrical resistivity, decomposition trouble was experienced at 4000°R. (auth)

2544 (WANL-TME-1687) WANL CALIBRATION FOR XE-2. Burlas, T. C.; Karako, E. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 186p. Dep. NTIS $12.50.

Westinghouse calibrations are provided for all Westinghouse-supplied instrumentation (thermocouples, strain gages, displacement gages torque and pressure transducers, resistance thermometers, accelerometers, calorimeters, and gamma detectors). (LTN)

2545 (WANL-TME-1963) NERVA DATA AND DOCUMENT MANAGEMENT PLAN. WANL Supplement. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1969. 108p. Dep. NTIS $8.50.

The WANL Supplement to the NERVA Data and Document Management Plan describes the Westinghouse approach for managing the identification, acquisition, storage, retrieval and delivery of data to the NERVA program activities. This Plan describes WANL's philosophy of data management, the Data Bank that is the basic element in the system and how it relates to data collection, storage and dissemination. The process of how data requirements are identified and how the documents are numbered for computer manipulation is also described. (auth)

2546 (WANL-TMI-015) DESIGN PROPERTIES FOR GRAPHITE. Hoppe, A. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Sep 1961. 15p. Dep. NTIS $4.00.

The design mechanical properties (compressive strength, modulus of elasticity, tensile strength, flexural strength) and thermal conductivity are given as functions (curves) of temperature for various grades of graphite. The strength curves increase with temperature up to at least 4000°F. (LTN)

2547 (WANL-TMI-063) HEATING IN THE SHIELD. Clement, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Mar 1962. 2p. Dep. NTIS $4.00.

Preliminary calculations, which involve several assumptions, suggest that the neutron and gamma heating in a LiH-SS shield placed above a B-4 reactor core will be greater on the side of the shield adjacent to the core than was previously calculated for a B-1 core. (LTN)

2548 (WANL-TMI-085(Vol.1)(Sec.1)) COMMUNICATIONS, CONTROL, GUIDANCE, TELEMETRY (MEMORANDUM). Wilker, L. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 10p. Dep. NTIS $4.00.

A series of lectures is begun with introductory notes from the lecture on binary mathematics. (LTN)

2549 (WANL-TMI-085(Vol.1)(Sec.2)) BINARY COUNTERS. Wilker, L. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 May 1962. 9p. Dep. NTIS $4.00.

2550 (WANL-TMI-085(Vol.1)(Sec.4)) COMMAND LINKS. Volume 1, Section 4. Wilker, L. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Jul 1962. 9p. Dep. NTIS $4.00.

Radio communication with space vehicles is discussed. Intelligent information is usually transmitted by modulation of a carrier wave (amplitude, frequency, phase, pulse or Doppler modulation are possible types). Ultra high and super high frequencies can penetrate the ionosphere, whereas medium and high frequency waves are more likely to be reflected back to earth. At the vehicle the message enters at the antenna, is fed to the transponder receiver, demodulated, converted to the proper form and fed to the decoder. Data returning from a space vehicle is fed from the antenna to a receiver, through a data processing system and finally to a multiplexer. (LTN)

2551 (WANL-TMI-120) CALCULATION OF EFFECTIVE BORON CROSS SECTIONS IN THE REFLECTOR FOR ONE DIMENSIONAL CALCULATIONS. Stevens, C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1962. 4p. Dep. NTIS $4.00.

2552 (WANL-TMI-144) PRESSURE DROP ACROSS WIRE MESH. Howarth, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa (USA). Astronuclear Lab.). 6 Jul 1962. 3p. Dep. NTIS $4.00.

Problems of screen location and specification of pole and wire size of a filter to prevent large particles in the liquid hydrogen from clogging reactor core channel orifices are discussed. (LTN)

2553 (WANL-TMI-162) MODEL TESTING REQUIREMENTS. DeZubay, E. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jul 1962. 12p. Dep. NTIS $4.00.

In the course of the development of components involving the flow of fluid, the question of the use of models arises frequently. The ability of a given model to predict the behavior of the prototype is always open to doubt. The discussion considers the various requirements which would have to be met in order to obtain meaningful information relative to the flow of hydrogen at low temperature. From the considerations of similtude it becomes apparent that best simulation would be accomplished with the largest possible air supply at the highest reasonable pressure. The degree of compromise required by economic considerations will determine the degree of compromise in simulation. (auth)

2554 (WANL-TMI-246) TNS: AN IBM 7090 PROGRAM FOR COMPUTING THERMAL NEUTRON SPECTRA AND MULTITHERMAL GROUP CROSS SECTIONS. Stevens, C. A.; Young, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1962. 28p. Dep. NTIS $4.50.

The theory underlying the Thermal Neutron Spectrum (TNS) computer program is described. Detailed instructions for the use of the program are included. TNS calculates the thermal neutron spectra for an infinite homogeneous medium. It also generates spectrum-averaged cross sections for up to twenty thermal groups, including transfer coefficients between the groups. The program has been used successfully at WANL. In nuclear reactors in which the thermal neutron spectrum varies rapidly as a function of position, the use of one thermal neutron group in diffusion or transport calculations has frequently given poor results. The output from TNS, when used with standard diffusion and transport theory programs, has led to considerable improvement. Segments of the computer program are taken directly from Reference (1). However, many changes and additions were incorporated into the TNS program. (auth)

2555 (WANL-TMI-256) NRX-A LATERAL SUPPORT. Revision No. 1. Villasor, A. P. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Sep 1962. 36p. Dep. NTIS $5.00.

Calculations involving spring pressure required to keep the NRX-A core bundled during lateral acceleration are presented. The effects of friction are included: in resisting a force friction helps the spring action, but conversely friction keeps the core from returning exactly to its zero position. Otherwise, small changes in the spring deflection do not affect the carrying capacity of the spring. The spring system can carry lateral accelerations of nearly 46. (LTN)

2556 (WANL-TMI-365) FATIGUE FAILURE OF A B-1 MODULE. Miller, D. F. (Westinghouse Electric Corp., Pittsburgh, Pa (USA). Astronuclear Lab.). 9 Nov 1962. 3p. Dep. NTIS $4.00.

A B-1 module was vibrated as a cantilever to determine the time necessary to fail the module in fatigue. The stress level was slightly over 1000 psi single peak amplitude, which corresponds to one-half inch double amplitude differential between tip and base. The length of the cantilever was chosen nearly one-half the reactor core length to duplicate the type failure in the Nevada tests in which expansion effectively locked the modules together near the center of the core. Under the laboratory conditions, noted, the module failed after 7.92 hours, which corresponds to 0.57×10^6 cycles. Since this time was much longer than the Nevada failure time, it indicates that vibration alone did not cause failure, but that it was due to a combination of the effects of vibratory stress, thermal stress, and direct stress due to pressure. (auth)

2557 (WANL-TMI-366) MONTE CARLO STATUS REPORT. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Nov 1962. 11p. Dep. NTIS $4.00.

The status of the Monte Carlo method for shielding calculations is given. The computer program simulates neutron and gamma ray histories in reactor-shield assemblies. The input data required and the neutron and gamma events treated are listed. The advantages of the particular program are developed. (LTN)

2558 (WANL-TMI-377) MECHANICAL PROPERTIES OF VARIOUS KIWI B5 SHIELD COMPONENTS. Schreiber, J. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1962. 8p. Dep. NTIS $4.00.

The mechanical properties (tensile and ultimate loads, percent elongation and spring constants) are recorded for capsule tubes, capsules with end plugs, pull shoulders and sections of top and bottom plates. (LTN)

2559 (WANL-TMI-396) NRX-A1 CORE SUPPORT SPRING MATERIAL. Villasor, A. P. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Nov 1962. 2p. Dep. NTIS $4.00.

The exact thickness of graphite cloth (Grade WCB, National Carbon Company) is ordinarily difficult to measure and so, in its stead, the weight is furnished as a quality criterion for the springs of the lateral support. (auth)

2560 (WANL-TMI-426) NRX-A REFLECTOR UPPER SUPPORT RING. Schmertz, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Dec 1962. 16p. Dep. NTIS $4.00.

The axial deflection at the quick disconnect flange and the radial deflection at the reflector support ring due to the pressure drop through the core (120 psi load) have been calculated to be approximately 0.004 in. (LTN)

2561 (WANL-TMI-449) STATISTICAL THEORY OF TWO PHASE FLOW AND DETERMINATION OF LOCAL DYNAMIC VAPOR FRACTIONS. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jan 1963. 28p. Dep. NTIS $4.50.

Based on fluid temperature data obtained from the study of pressurized cool-down to liquid hydrogen, the mechanisms of two-phase flow in the film boiling, transitional and nucleate boiling regions have been discussed in detail. It has been shown that in the film boiling and transitional regions, thermodynamic equilibrium does not exist between the vapor and the liquid. Based on the postulated mechanisms, a statistical theory of two-phase flow has been devel-

oped. The theory provides a simple method for the determination of dynamic vapor fractions (non-equilibrium mass fraction vapor) from temperature traces. The vapor fractions determined by this method have been verified by those estimated by an independent procedure. The principles developed suggest the design of a quality meter for the determination of non-equilibrium vapor fractions. The meter is a potentially parentable device. (auth)

2562 (WANL-TMI-458) MEASUREMENT OF THE SHUTDOWN REACTIVITY IN SUBCRITICAL CONFIGURATIONS. Rothman, A. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Jan 1963. 7p. Dep. NTIS $4.00.

An experimental method of measuring the shutdown reactivity of a subcritical core is outlined. The method consists of two measurements: (1) A pulsed neutron measurement of Rossi-α; and (2) Decay of the neutron population following source withdrawal from a subcritical configuration. Since such measurements, if feasible, make initial approaches to critical less hazardous, a pulsed neutron source would be a good addition to the facility. (auth)

2563 (WANL-TMI-458(Add.1)) CALIBRATION OF CONTROL DRUMS IN A SUB-CRITICAL ASSEMBLY. Rothman, A. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Feb 1963. 3p. Dep. NTIS $4.00.

A method of calibrating control drums in a subcritical assembly with a source is given as an addendum to WANL-TMI-458, which discusses the measurement of shutdown reactivity in a subcritical core. WANL-TMI-458 illustrated a method of measuring the shutdown reactivity in a sub-critical core by using a source jerk technique together with a pulsed neutron measurement of α. If instead of yanking the source, we drive in a control element, interpretation of the kinetics equations on a core of known reactivity allows us to measure the control drum worth. (auth)

2564 (WANL-TMI-471) PULL-OUT FORCE REQUIRED TO REMOVE THE POISON WIRES FROM THE ELEMENTS SIMULTANEOUSLY. Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Jan 1963. 2p. Dep. NTIS $4.00.

2565 (WANL-TMI-472) NRX-A INNER REFLECTOR CYLINDER STRESS. Schmertz, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jan 1963. 14p. Dep. NTIS $4.00.

Bending stresses in the reflector cylinder wall arising from a temperature variation along its length are evaluated. (LTN)

2566 (WANL-TMI-479) SUMMARY REPORT ON THE RE-ENTRY BURNUP OF GRAPHITE PARTICLES. Hargrove, H. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Feb 1963. 16p. Dep. NTIS $4.00.

The following conclusions may be drawn from these graphite re-entry studies: Shallow re-entry angles produced more burnup than steep angles for all particle sizes investigated. The smaller the particle, the less pronounced becomes the effect of re-entry angle on burnup. There is an initial particle size for which the maximum percent burnup cannot be exceeded. This size is approximately $\frac{1}{32}$ in. in diameter for a spherical particle. The maximum burnup obtainable is approximately 50%. The Martin report (MND-2517) has a mathematical error in the free molecule analysis which results both in greater burnup than can be theoretically achieved and the optimistic results they reported. The original WANL analytical study on graphite re-entry burnup as presented in WANL-TNR-039 is incorrect also, because the extrapolation of the Scala continuum flow equations into the transition and free molecule flow regimes is not valid, the results predicting higher mass loss rates and greater total burnup than can be theoretically achieved. (auth)

2567 (WANL-TMI-481) PRELIMINARY STUDY FOR A DESTRUCT SYSTEM. Villasor, A. P. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Feb 1963. 8p. Dep. NTIS $4.00.

When the reactor is allowed to go into excurison with the cooling hydrogen shut off, the heat generated is not sufficient to raise the pressure of the gas trapped in the voids to a level comparable to the bursting pressure of the vessel, principally because of the nozzle opening. Possibilities for modifying this destruct scheme are listed for further study. (auth)

2568 (WANL-TMI-488) SCREENING LOCATION CHANGE. Rieke, K. L.; Thomas, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Sep 1962. 2p. Dep. NTIS $4.00.

The effect of screen location on coolant pressure drop is discussed. Final drilling of the support plate is to be deferred till flow test data become available. (LTN)

2569 (WANL-TMI-500) TEMPERATURE DISTRIBUTION IN THE NOZZLE END SEAL. Minners, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Oct 1962. 3p. Dep. NTIS $4.00.

For the reactor operating at full load, steady state conditions and very high temperature gradients were calculated to exist in the stainless steel nozzle support flange and the stainless steel inner reflector support flange. (auth)

2570 (WANL-TMI-516) SIZE OF COOLANT SLOTS IN THE OUTER BAFFLE WELDMENT ASSEMBLY AND SEAL FLANGE. Black, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Nov 1962. 2p. Dep. NTIS $4.00.

2571 (WANL-TMI-519) SHIELD DOME END PLENUM SPACING. Rieke, K. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Sep 1962. 2p. Dep. NTIS $4.00.

An adaptation to a needed design change required moving the shield $\frac{1}{4}$ in. closer to the reactor core. This is the easiest way to meet the new requirement and involves at the most a 3.7% increase in the heating rate in the shield. (LTN)

2572 (WANL-TMI-549) COLOR CODING ORIFICES. Parsons, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Mar 1963. 7p. Dep. NTIS $4.00.

An investigation was made to find a method of color coding the various jet orifices with different hole sizes to facilitate assembly of the NRX A-1 core. High temperature paints, ceramic paints, temperature indicating paints, and cements were investigated. Various degrees of success were obtained. No one type of paint was found which had excellent adherency after application and after being subjected to 1500°F for one-half hour, yet was available in many colors, was easy to apply and use, and had a very thin coat after drying. Some colors of high temperature paints will do as an alternate method to that of colored plastic caps presently planned. (auth)

2573 (WANL-TMI-553) SIMULATED SUPPORT BLOCK TESTS. Parsons, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Jan 1963. 10p. Dep. NTIS $4.00.

The strength of the graphite support blocks that support the fuel elements can be affected by three design variables. This test was conducted to determine what noticeable effects, if any, can be observed by: Increasing the length (or height) of the support block from 2 to $2\frac{1}{2}$ inches; decreasing the depth of the cup seat in the support block from $\frac{3}{4}$ to $\frac{1}{2}$ inch; or tapering the cup seat slightly. Results indicated no increase in strength by increasing the support block length to $2\frac{1}{2}$ inches. Also no strengthening effect results from using a $\frac{1}{2}$ inch deep cup-washer seat instead of a $\frac{3}{4}$ inch seat. And, finally, negligible effects result from adding a slight taper to the cup seat in the block. In the actual block, the pyrolytic cup and washer were shown to fail first. This failure can be alleviated by: Increasing the physical dimensions of the cup and cup seat, or increasing the bearing area of the cup and washer (by obtaining the maximum bearing area from given design, tapering the cup-washer and seat, or using a pyro-washer between the pyrolytic cup and the support block). Method (1) provided such an increase in load capacity that other methods were not effectively evaluated. (auth)

2574 (WANL-TMI-593) DERIVATION OF LINEARIZED, DIFFERENCE-DIFFERENTIAL EQUATIONS FOR ANALOG COMPUTER STUDIES OF GAS-FLOW OSCILLATIONS. Stubbs, G. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Feb 1963. 27p. Dep. NTIS $4.50.

The basic heat transfer and flow equations applicable to studies of flow oscillations in NERVA engines are first linearized, then expressed as difference-differential approximations, and finally rewritten in a form suitable for analog computer solution. Block diagrams are presented which illustrate an analog procedure for solving the linearized, difference-differential equations. (auth)

2575 (WANL-TMI-611) NRX-A INNER REFLECTOR CYLINDER STRESS. Schmertz, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Mar 1963. 18p. Dep. NTIS $4.00.

The NRX A-1 inner reflector cylinder is analyzed to determine the thermal stresses that arise from axial and radial temperature gradients in the unrestrained cylinder. In addition, values are obtained for the stresses which occur in the cylinder when the surrounding aluminum barrel shrinks around it, compressing it as the temperature decreases. The stresses due to the restraint by the barrel are added to the thermal stresses for the unrestrained cylinder to obtain the total stresses due to thermal effects. The effect of the pressure exerted by the surrounding fluid on the cylinder, as well as other mechanical loads, are not included. The effect of perforations in the cylinder is likewise

omitted. The results of this analysis for two temperature profiles are summarized. (auth)

2576 (WANL-TMI-613) NRX-A1 INNER REFLECTOR AXIAL SUPPORT SPRINGS. Villasor, A. P.; Parsons, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Apr 1963. 10p. Dep. NTIS $4.00.

In order to verify the design of the axial support spring (Dwg. No. 963B450) a sample spring, made by the Raymond Spring Company was subjected to testing. It was desired to determine: If the design physical dimensions were obtained by the supplier; the load-deflection curve; the perpendicularity of the spring when free standing; and the resistance to buckling under load. It was found that the wire diameter was smaller than per drawing by about 2%. The free length was found to be greater by 3%. The load-deflection curve for the spring is shown. The spring was not truly perpendicular with the ground ends which had an influence on the buckling tendency. The spring was found to buckle before 60 pounds load was obtained. The lateral load required to induce buckling of the spring at various loads is shown. (auth)

2577 (WANL-TMI-631) NRX-A STAINLESS STEEL FAILURE TEST. Inge, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 May 1963. 5p. Dep. NTIS $4.00.

Experimental work to test the strength of a stainless steel tube and pyrolytic graphite tube under an axial load simulating the drag force during full flow reactor operation was completed. The stainless tubes are located in the central unloaded graphite fuel element and serve to line the pyrolytic graphite tube or sleeve through which the tie rod passes. Should the stainless steel lip deform or should part of the pyrolytic graphite tube break off and be carried downward into the bottom portion of the channel surrounding the tie rod, it would almost certainly choke off the flow of by-pass coolant through the channel, and around the tie rod. Consequently, the tie rod would heat up rapidly and eventually cause structural failure. In the test the pyrolitic graphite failed in hoop tension. No visible deformation occurred to the stainless steel tubes tested. (auth)

2578 (WANL-TMI-632) ESTIMATE OF LATERAL FLOW THROUGH NRX-A FUEL ELEMENTS. El-Waziri, A. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 May 1963. 3p. Dep. NTIS $4.00.

Preliminary results suggest that the lateral flow of hydrogen through slightly porous graphite fuel elements is small enough to have a negligible effect on coolant tube flow control by orificing. Values far less than 0.1 percent of the design channel flow are indicated by preliminary results. (LTN)

2579 (WANL-TMI-646) NRX-B LATERAL SUPPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 May 1963. 15p. Dep. NTIS $4.00.

The NRX-B lateral support concept presented relies upon a peripheral shear distribution to support the core and a radial pressure to insure stability of the fuel element bundle. An interlocking arrangement between the fuel elements and graphite support "shoes" provides for core location relative to the graphite barrel and bottom support plate. The employment of a high rate tangential spring in combination with a low rate radial spring produces minimum shock induced core deflections while maintaining a relatively constant radial core bundling pressure. This radial pressure must be sufficiently low to permit fuel element differential axial expansion and insure a uniform load distribution on both the core transition blocks and the bottom support plate. The minimum permissible radial bundling pressure is shown to be equal to the product of the core radius, effective core density, and the number of g's lateral shock loading which for the NRX-B reference core amounts to approximately 1 psi per g. (auth)

2580 (WANL-TMI-647) ANALYSIS OF LASL CORE BUNDLING PRESSURE TEST. Brusalis, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 May 1963. 8p. Dep. NTIS $4.00.

This is an analysis, based on a test conducted by LASL personnel, to determine whether relative expansion of two pieces of graphite under bundling loads would result in failure of the graphite. A 24 inch length of $\frac{5}{8}$ inch wide and $\frac{1}{2}$ inch thick Graphitite G specimen was sandwiched between two plates of steel with a bundling pressure of 320 psi and then heated in a furnace to 480°F. From all external appearances, the graphite did not crack, even though LASL calculations indicated that it should. The Reactor Mechanical Design calculations, based on the above conditions, indicate that no definite conclusions can be made as to whether the test specimen should have or should not have failed. The probability of survival as a function of the expected range of the coefficient of friction and nominal material properties is tabulated: It is 97 percent for u = 0.01 and falls rapidly to 1.3 percent for u = 0.20. (auth)

2581 (WANL-TMI-683) PROPOSED DESIGN OF THE NERVA-TYPE TIE-ROD TEST AT GTR. Stoltz, R.; Solberg, D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1963. 20p. Dep. NTIS $4.00.

To verify that NRX tie rods are operable in the anticipated environment, it is planned to expose a shortened, pre-stressed tie rod to an integrated neutron flux of 3×10^{17} nvt in a 100 hour test with one end at 1000°R and the other at 140°R (liquid nitrogen). (LTN)

2582 (WANL-TMI-689) ANALYSIS OF FLOW OSCILLATIONS AND AERO-ELASTIC VIBRATIONS IN THE KIWI B-4A AND NRX-A REACTORS. Bodenschatz, C. A.; DeZubay, E. A.; Morrison, H. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1963. 77p. Dep. NTIS $7.00.

The results of various analyses to investigate fuel element or core vibrations of KIWI B-4A and NRX-A reactors are presented. Primary emphasis has been placed upon understanding pressure and flow oscillations which could initiate or sustain core vibrations. In all the analyses, analytical or empirical expressions describing a model of the physical situation were derived and these results were applied to the KIWI B-4A and NRX-A designs and their actual or predicted start-up conditions. The following areas were investigated for potential fluid flow and pressure oscillations: Flow schematic of entire engine, two-phase flow, vortex shedding, pressure oscillations within plenum chambers, nozzle resonance, and shock conditions at the nozzle. Possible fuel element vibrations induced by gas flow have been grouped as follows: Vibrations in parallel flow and radial flow as a forcing function for vibrations. Some of the above areas investigated might be capable of producing oscillations or vibrations in the range of 20 to 33 cps comparable to the results of the KIWI B-4A test: Flow schematic of entire engine, two-phase flow, or vibrations in parallel flow. (auth)

2583 (WANL-TMI-699) COMPARISON OF GROUP CONSTANTS CALCULATED USING P1MG AND MUFT. Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Jun 1963. 4p. Dep. NTIS $4.00.

Some complications in reactor analysis calculations resulting from the use of different computer programs using data on three different library tapes are discussed. Certain procedures for consistent results with both programs are given and an error in one library tape is mentioned. (LTN)

2584 (WANL-TMI-710(Add.1)) RELEASE OF HOLD ON INSTRUMENTATION SUPPORT SLEEVE ORIFICE HOLES. Gormley, O. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Jul 1963. 1p. Dep. NTIS $4.00.

The flow areas requested for the satisfaction of the conditions for the release of the holds placed on the instrumentation support sleeve orifice holes have been found to cause structural difficulties. Therefore, the flow through the control drum drive shaft port with the maximum orifice flow areas available has been reevaluated. Adequate flow is provided through the control drum drive shaft ports with 18-.218 dia. holes in the split bushing, 12-.218 dia. holes in the sleeve, and a full radius on the inlet of the 12-.218 dia. holes. Therefore, the hold placed on the drawings of these parts is released. (auth)

2585 (WANL-TMI-717) LATERAL SUPPORT SPRING ASSEMBLY TESTS IN MULTIPLE ASSEMBLY TEST RIG. Schmertz, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jul 1963. 24p. Dep. NTIS $4.25.

Three possible types of Lateral Support Spring Assemblies have been endurance cycled in a multiple assembly test rig. The multiple assembly rig cycles eight spring specimens at once, and has the capability of driving the spring assemblies in any one of three pre-selected directions of loading—0°, 30°, and 45°. The three types of Spring Assemblies tested were: A compound arrangement of two helical springs of different stiffness, a helical spring, and graphite cloth strip rolled into a cylinder. Static load-deflection tests and length measurements were performed on the assemblies prior to endurance testing, and also at various levels of cycle accumulation, to determine the effect of extended cycling on the spring properties. In a similar manner, graphite dummy components, used to simulate reactor components associated with the spring assemblies, were measured and weighed to evaluate the extent of wear of the graphite after accumulated cycling. Negligible changes in the spring rate and in load-deflection curves were found after 50,000 cycles for the compound springs, and after 37,000 cycles for the single spring (but a slight permanent set developed). The graphite cloth springs were not springy enough to maintain contact at 10 Hz and showed some deterioration of the cloth after 5,000 cycles. (auth)

2586 (WANL-TMI-893) NORMALIZER (FOR NORMALIZING HIC ONE DIMENSIONAL REACTION RATES TO TWO DIMENSIONS). Heiser, P. C. (Westinghouse Electric Corp., Pittsburth, Pa. (USA). Astronuclear Lab.). 13 Dec 1963. 29p. Dep. NTIS $4.50.

NORMALIZER is a code written for the IBM-7090 which takes reaction rates produced by the one dimensional code (HIC) and normalizes the data to a two dimensional distribution. The fluxes used for the HIC calculations are obtained from the one dimensional diffusion code P1 MG. The fluxes used in the normalizer program are obtained from CURE, a two dimensional diffusion code. Two separate codes, NORMALIZER "A" and "B," were necessary due to computer storage space limitations. Both codes are written in Fortran. The codes compute for each region the relative radial and axial distribution of heating rate, fission rate, capture gamma rate and inelastic scattering gamma rate. (auth)

2587 (WANL-TMI-1005) TORQUE TEST, BARREL RETAINING SCREWS. Kotulak, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1964. 10p. Dep. NTIS $4.00.

In prior reactor assembly, it was determined that the recommended design torque did not apply sufficient preload to the barrel retaining screws. The torque required to seat anchor nuts in some cases was greater than the recommended design torque. In no case, did the recommended torque provide the necessary design preload on the screws. The maximum torque which could be applied with a Phillip's screwdriver was not sufficient to twist off the screw or damage the threads in any way so in every case tested, the screw head was the limiting factor in obtaining maximum torque. Failures occurred when the screwdriver slipped in the screw head; and in one case, the screwdriver tip actually broke off. For this reason, the screw head should be redesigned to accept on Allen wrench. Since the maximum torque required to seat the screw against the barrel and nut was 28 in.-lb, and the minimum torque which resulted in failure was 62 in.-lb, it is apparent that some mid-range torque value between these limits should be selected as the proper torque to be applied to the barrel retaining screws. An appropriate acceptable value would be 45-50 in.-lb. (auth)

2588 (WANL-TMI-1031) FATIGUE CHARACTERISTICS OF BLOCK II LATERAL SUPPORT SPRINGS. Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1964. 18p. Dep. NTIS $4.00.

New designs of lateral support springs are being considered to eliminate the problem of stripping of the threads in the lateral support spring bracket mounting holes. One possibility under consideration is drilling the spring and attaching it by passing a bolt through the spring and the inner reflector wall. One, two, and three-hole configurations were tested. Based on the results of only two tests of each configuration, it is quite apparent that the mounting holes in the support springs adversely affect their fatigue life. All springs, including the plain NRX-A type, failed when subjected to the maximum cyclic loading of ±0.200 about the mean setup deflection of 0.250 in. The cyclic life to crack initiation of the 3-hole and 1-hole configuration was approximately 10,000 and 16,250 cycles, respectively. The life for the 2-hole springs varied from 38,400 to 97,650 cycles with a different mode of fracture in the two tests. The longer life spring failed in the uniform stressed section approximately 1 in. from the mounting holes. At one-half cyclic amplitude the 1-hole configuration sustained 2×10^6 cycles without failure. Under maximum cyclic displacement, the plain springs failed after 150,100 and 317,190 cycles. At one-half cycles amplitude, the plain springs did not fail after 2×10^6 cycles. (auth)

2589 (WANL-TMI-1041) DTK ONE-DIMENSIONAL TRANSPORT THEORY CODE. Kopp, L. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Apr 1964. 74p. Dep. NTIS $6.75.

A one-dimensional neutron transport code, developed for reactor physics calculations in the NERVA program is described. (JWR)

2590 (WANL-TMI-1058) ANALYSIS OF KIWI-B1-B NOZZLE SMEARS. Henninger, W. A.; Grandy, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Apr 1964. 8p. Dep. NTIS $4.00.

Of the nuclides analyzed, five were identified as major contributors to the total activity on the nozzle surface. The nuclides were ^{141}Ce, ^{140}Ba-^{140}La, ^{95}Zr-^{95}Nb, ^{91}Y, and ^{89}Sr. These nuclides account for more than 99 percent of the total activity. The smear technique is successful for obtaining a representative sample of nozzle surface activity. Removal of surface activity with the smear technique indicates that decontamination of the nozzle surface for post irradiation studies could be accomplished with relative ease. (auth)

2591 (WANL-TMI-1137) OUTER REFLECTOR SECTOR THERMAL SHOCK TEST MODEL TEMPERATURE DISTRIBUTION CALCULATIONS. Lee, A. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jun 1964. 5p. Dep. NTIS $4.00.

2592 (WANL-TMI-1387) FURTHER AFTER SHUTDOWN DOSE MEASUREMENTS ON THE PAD. Woodsum, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Jan 1965. 6p. Dep. NTIS $4.00.

Additional, after shutdown, radiation dose measurements needed at test cell A are specified so as to define the source (wall, pad, rails) and how the dose falls off with distance from the pad. (LTN)

2593 (WANL-TMI-1389) ADDITIONAL RADIATION AND SHIELDING EXPERIMENTS NEEDED AT WANEF. Woodsum, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Jan 1965. 6p. Dep. NTIS $4.00.

2594 (WANL-TMI-1413) POROSITY OF UNCOATED UNFUELED ELEMENTS. Burack, R. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Mar 1965. 3p. Dep. NTIS $4.00.

In a preliminary experiment it was found that the permeability of helium through an uncoated graphite fuel element was only about 10% of the total expected interstitial flow. (LTN)

2595 (WANL-TMI-1481(Rev. 0)) PROJECT NERVA: REACTOR ANALYSIS TEST REQUEST. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jun 1965. 2p. Dep. NTIS $4.00.

A need is documented for experimental data concerning fast and thermal neutron flux and gamma dose in and around the NRX-A3 Privy Roof Mounted Shield in order to check nuclear heating rate and nuclear environment calculations. The mathematical analysis is extremely difficult and experimental verification of the calculations is needed to determine and improve the accuracy of the analysis. (LTN)

2596 (WANL-TMI-1483) DETERMINATION OF MINIMUM INSULATION RESISTANCE REQUIREMENTS FOR OUTER REFLECTOR GAS TEMPERATURE THERMOCOUPLES. Chambers, G. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Jun 1965. 9p. Dep. NTIS $4.00.

Based on this analysis, an insulation resistance of one megohm minimum is permissable for the subject thermocouples. This is assuming that other thermoelectric effects (such as those between the copper-constantan and stainless steel sheath) are negligible and also that irradiation will not cause a decrease in I. R. less than 500K ohms. It is recommended that actual tests on the effects of insulation resistance on sensor performance be continued in respect to the irradiation, temperature, and other related effects. (auth)

2597 (WANL-TMI-1485) PAX NINE GROUP ELEMENT LIBRARY. Bevard, D. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jun 1965. 7p. Dep. NTIS $4.00.

A nine group set of pertinent element cross sections averaged over the correct spectra for use in reactivity and other ambient condition NERVA calculations has been generated. Use of the library gave results almost identical to standard GAM-TNS macroscopic cross section calculations. (auth)

2598 (WANL-TMI-1493) CHECK ON PERIOD-REACTIVITY CONVERSION. Sipush, P. J.; Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Jun 1965. 5p. Dep. NTIS $4.00.

The assumption that the same effectiveness may be assigned to each delayed neutron group when employing the in-hour equation to the reactivity associated with a stable positive period in NERVA preassembly experiments is examined. (JWR)

2599 (WANL-TMI-1501) EFFECTIVE THERMAL CONDUCTIVITY OF MULTILAYERED HEAT SHIELDS. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1965. 24p. Dep. NTIS $4.25.

The effective thermal conductivity of multilayers of insulation materials has been derived for the general case where heat transfer occurs by conduction across the solid layers and conduction and radiation across stagnant gas layers. Equations were also given for special cases and specific geometries, i.e., operation in a vacuum, parallel planes, etc. On the basis of heat conduction across successive layers of pyrolytic graphite foil and stagnant gas, a simple equation was derived for the effective thermal conductivity of pyrofoil laminates. The theoretical effective thermal conductivities calculated for hydrogen is presented in graphical form for a range of bulk densities. The results show that the ef-

fective thermal conductivity varies appreciably with the bulk density. At temperatures below 3500°R, the effective thermal conductivities are lower than those for pyrographite, but above 3500°R, the values are higher than those for pyrographite. The calculated results have compared favorably with limited experimental data. (auth)

2600 (WANL-TMI-1509) NRX-A CONTROL DRUM HOUSING STRESSES. Eggers, A. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Aug 1965. 18p. Dep. NTIS $4.00.

The analysis performed to determine the cause of the control drum housing weld failure in NRX-A3 is summarized. In addition, the NRX-A4 housing modifications are discussed and recommendations for NRX-A5 and later reactors are included. It is concluded that the number 11 NRX-A3 control drum failed due to axial interference of the beryllium cylinder with the bearing shafts (end caps) at cryogenic temperatures. This occurred because the axial shrinkage of the aluminum housing was greater than that of the beryllium cylinder (due to the difference between coefficients of expansion). Bending effects also tend to occur at the weld due to radial interference of the aluminum housing and beryllium cylinder near the ends of the housing. (auth)

2601 (WANL-TMI-1510) NUCLEAR ANALYSIS OF NRX-A4/EST PRIVY ROOF MOUNTED SHIELD AND SHIELD STAND. Capo, M. A.; Woodsum, H. C.; Nassano, R. N.; Stephenson, L. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Aug 1965. 64p. Dep. NTIS $6.25.

Based on radiation dose, radiation heating, radiation of test pad after 90 days measurements and safety factor given, the design requirements were met. A little extra localized shielding is necessary in some areas. (LTN)

2602 (WANL-TMI-1517) MEASUREMENTS OF GAMMA DOSE RATE AND FAST AND THERMAL FLUX IN NRX-A6 REACTOR AT WANEF. Woodsum, H. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Aug 1965. 6p. Dep. NTIS $4.00.

A requirement for gamma dose and fast and thermal neutron flux measurements, especially in the reflector region of NRX-A6, is justified and the nature of the required data outlined. (LTN)

2603 (WANL-TMI-1522) COMPARISON OF WANL CORROSION DATA WITH ICAP: HHT-6.2-1, SHORT SLIT. Kanter, I. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Aug 1965. 5p. Dep. NTIS $4.00.

The measured corrosion of a graphite slit at 3500°R and the given hydrogen flow conditions is compared with that calculated by the ICAP program using different kinetic assumptions. (LTN)

2604 (WANL-TMI-1531) USE OF EPOXYS FOR MOISTURE SEALING METAL SHEATHED INSTRUMENTATION CABLES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 4p. Dep. NTIS $4.00.

The two major disadvantages of epoxys when compared with the present glass seal method are the relatively long curing or installation periods and its radiation limitations. If epoxy was used as only a temporary seal it would not need to be radiation hardened, but why use a more time-consuming method. The test results for the epoxys do not indicate it to be any more effective than the glass method in respect to moisture sealing. The experience of using the epoxy on NRX-A1 and NRX-A2 show that there were definitely problems, and present tests indicate these problems are probably typical for epoxys. The only real advantage in the epoxys favor is that it does not require as much art as installing the glass (installed with an open flame torch). It may seem that cost is an advantage, since epoxys are relatively inexpensive; however, counting the cost of the time saved by the glass method, the epoxy method could be much more expensive in the long run. (auth)

2605 (WANL-TMI-1538) FUEL ELEMENT CHIPPING DEFECTS IN THE REACTOR ASSEMBLY AREA. Wandell, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Sep 1965. 17p. Dep. NTIS $4.00.

An investigation into the chipping of fuel elements in reactor assembly is described and the recommendations to minimize the occurrence are listed. (LTN)

2606 (WANL-TMI-1544) NRX-A5 SPECIAL "BLOCKLESS" CLUSTERS PER DRAWING 937J938. Eggers, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Sep 1965. 6p. Dep. NTIS $4.00.

A preliminary investigation of the NRX-A5 special "Blockless" cluster layout per Drawing 937J938 has indicated that the design, as shown, is not satisfactory for reactor use. The various versions of the design all rely on large keys bonded to the inlet end of the fuel elements to support them against axial loading. These keys bear against the inlet face of the shortened central element. Additional small secondary keys are located near the nozzle end of the fuel elements to retain the elements in case of a transverse failure below the primary keys. Sufficient axial clearance is provided to prevent loading of the lower keys under normal conditions. The blockless cluster concept was conceived to eliminate the fuel element-support block interface and associated corrosion problems. When the support block crack problem was discovered, it was also hoped that the blockless design would solve that problem. (auth)

2607 (WANL-TMI-1558) PIPING FLEXIBILITY ANALYSIS FOR TEST CELL "A" CRYOGENIC PROCESS LINES. Johnson, F. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. 37p. Dep. NTIS $5.00.

The results of a thermal stress analysis indicate that all cryogenic piping systems and their interconnecting lines within the Flow Control Room of Test Cell "A" have sufficient flexibility to safely absorb the change in length resulting from the expected temperature variations. The results show that the maximum expansion stress for all systems analyzed is within the allowable stress range specified by the ASA Code for Pressure Piping. All thermal stress problems were primarily analyzed by the Service Bureau Corporation. The detailed computation methods used in the SBC program for determining the forces, moments, stresses, deflections and rotations were considered as proprietary information; therefore, they were not obtainable. However, all SBC computations of stress intensification factors and expansion stress ranges used formulas specified in the ASA Code for Pressure Piping. The results of the other piping stress analysis also indicated that the stresses sustained by the piping as a result of pressure, momentum and weight loading were not significant. These stresses were substantially less than the allowable stress value specified by the ASA Code for Pressure Piping. (auth)

2608 (WANL-TMI-1573) PROJECT NERVA: REACTOR ANALYSIS TEST REQUEST. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Oct 1965. 5p. Dep. NTIS $4.00.

The need for more radiation and shielding information is justified by (1) higher than predicted radiation in the reflector region and outside the reactor in NRX-A2 and NRX-A3 tests and PAX data and (2) a bias between NTO and LASL measurements and those of WANEF. On the basis of the above and other information given, the requested data are specified: intercalibration, dosimeter types (some with and others without cadmium cover, foils of different thickness and wires of different diameter, orientation and geometric location of dosimeters, etc.) for gamma radiation and fast and thermal neutrons. The accuracy should be within ±10% and corrected for background and decay and normalized to power level. (LTN)

2609 (WANL-TMI-1587) INSTRUMENTATION HANDLING, STORAGE AND TRANSPORTING METHODS. Swope, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Nov 1965. 22p. Dep. NTIS $4.25.

The methods to be used for handling, storage and transport of reactor grade instrumentation are given. Storage and transporting tubes will be used, where feasible, which can be purged and pressurized with dry nitrogen. Sensing ends of thermocouples will be protected by plastic caps or by shrink tubing. Kempack will be placed around each transducer. Before use electrical checks will be made and recorded. (LTN)

2610 (WANL-TMI-1598) EVALUATION OF DIODE FAILURE EFFECTS IN FR-110. Starek, R. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Nov 1965. 9p. Dep. NTIS $4.00.

During a review, a question was raised concerning the reliability of the diode logic circuit presently used in FR-110 (an average circuit), specifically, the effect of a diode short under conditions of amplifier mismatch. A bread board model was constructed and systematically tested. With one exception, all circuit failure configurations tested resulted in an error of less than 1.5 percent, which is regarded as not excessive and tolerable for the application considered. (LTN)

2611 (WANL-TMI-1613(Suppl.)) CONVERSION OF OUR DIGITAL COMPUTER PROGRAM TO THE WESTINGHOUSE CENTRAL COMPUTER. Saalbach, C. P.; Carroll, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1966. 6p. Dep. NTIS $4.00.

2612 (WANL-TMI-1634) THERMAL GRADIENT TESTS ACROSS THE GRAFOIL IN THE NRX-A6 HOT BUFFER PERIPHERY DESIGN (EML-86). Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jan 1966. 5p. Dep. NTIS $4.00.

Heat transfer tests were performed to obtain test data which could be used in the analysis of the temperature profile of the NRX-A6 outer reflector inner surface between cooling holes. The two specimen assemblies shown were tested. Each simulated the spacer ring-pyrofoil insulation-outer reflector interfaces. The heat data obtained indicated that the pyrofoil washers and spacer ring cavity had a strong influence on the maximum temperature developed midway between the coolant holes in the steel bar simulating the reflector inner surface. (auth)

2613 (WANL-TMI-1636) QUALIFICATION TESTS OF NRX-A5 SEAL BLOCK ASSEMBLY BACKUP DESIGN (EML-76). Bove, G. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Feb 1966. 3p. Dep. NTIS $4.00.

Thermal cycle fatigue tests and a resonance survey of a backup NRX-A5 seal block assembly have been completed. These tests were required to prove the ability of this design to contain pressure when subjected to reactor operating environments. This backup design is similar to the prime design seal block assembly except that a Conoseal seal (clamp) is used on final assembly in lieu of stainless steel welds. Two assemblies were subjected to twelve thermal cycles (−50 to −320°F) with continuous vibration at 240 cps and 2g input acceleration. A total of 4,320,000 vibration cycles were applied during the temperature cycling. No loosening of the Conoseal seal or other failures were noted during the testing. (auth)

2614 (WANL-TMI-1644) INSULATED CONTROL DRUM BOW TESTS. Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Feb 1966. 28p. Dep. NTIS $4.50.

Control drum thermal bow tests were performed to evaluate the effectiveness of a thermal barrier proposed for reducing the maximum drum bow developed during reactor startup. Bow measurements of an NRX-A3 type control drum were made with and without a thermal barrier to directly evaluate the reduction in bow attributable to the barrier. Under the same flow and initial drum temperature conditions, the maximum bow measured with the thermal barrier was 70 per cent lower. (auth)

2615 (WANL-TMI-1650) HOLLOW TIE ROD. Moritz, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Mar 1966. 12p. Dep. NTIS $4.00.

Fifty hollow tie rods of Inconel 718 were made for NRX-A5, so that thermocouples could be installed in them for the accurate measurement of temperatures of the tie rod material at the nozzle end of the reactor. The first set fabricated for NRX-A4 had a low ductility, but those made for NRX-A5 were satisfactory (tensile stress 0.2% yield 194 ksi, ultimate tensile stress 225 ksi and elongation 8.9 percent). (LTN)

2616 (WANL-TMI-1656) XE-1 CONTROL DRUM SCRAM SPRING TESTS. Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Nov 1966. 5p. Dep. NTIS $4.00.

Cyclic fatigue tests were performed on the XE-1 control drum spring and associated NRX-A hardware to determine the structural adequacy of the assembly under cyclic loads at ambient and cryogenic temperatures. After 1000 cycles at each temperature, inspection revealed no evidence of structural damage. The spring rate remained within the lower and upper limits of the pretest data. (LTN)

2617 (WANL-TMI-1660) DATA ANALYSIS OF NRX-A5 REDESIGNED CONTROL DRUM BOW TEST WITH HELIUM. Lee, A. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Mar 1966. 22p. Dep. NTIS $4.25.

The helium cold flow test results of the NRX-A5 redesigned control drum bow test were analyzed. Comparisons of the calculated and measured drum temperature response and the resulting bows show the agreements are reasonably good. Results from analysis show that the maximum thermal bow at the highest tested flow ramp of 3.0 lb/sec^2 (equivalent reactor startup ramp with hydrogen) and initial material temperature of 590°R is about 0.017 in. The tests also show that the effect of initial material temperature and flow ramp on the thermal bow of the drum is small. (auth)

2618 (WANL-TMI-1683) XE-1 CONTROL DRUM SYSTEM FAILURE MODE ANALYSIS. Wandell, G. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jun 1966. 28p. Dep. NTIS $4.50.

2619 (WANL-TMI-1694) REUSE OF BERYLLIUM REFLECTORS. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jul 1966. 10p. Dep. NTIS $4.00.

The possibility of reuse of used beryllium reflectors is considered and rejected (even if special high purity beryllium is used). Even after a year, the radioactivity from a reflector fabricated from commercial beryllium and used in an engine for more than 5 or 10 minutes at full power is sufficient to prevent reuse. Since the reflector design may have changed the possibility of reprocessing the beryllium (either chemically or electrolytically) was considered, but analyses confirmed that such material would be too hot after a year. Reuse may be possible with higher purity beryllium, short reactor runs and remote handling. Concentrations of Sc, Cs, Co and Ta would have to be below 1 ppM. In the past radioactivity from reflectors has been higher than predicted (due to more scandium than specified, longer reactor runs, flux prediction errors) and it may not decay as rapidly as predicted (due to overlooked or underestimated impurities with long lives, which are not easily determined shortly after irradiation). (LTN)

2620 (WANL-TMI-1695) TENSILE PROPERTIES OF INCONEL SHEET STRIPS FOR NRX-A6 DISPLACEMENT TRANSDUCERS. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Jul 1966. 3p. Dep. NTIS $4.00.

Displacement transducers, being developed for the purpose of monitoring relative radial motion between the core and outer reflector of the A6 reactor, employ a cantilever beam made of Inconel sheet material. Due to the high bending stresses that are developed under the anticipated motions there is some concern whether the yield strength of the material may be exceeded, in which case the non-linearity of the transducer output would reflect an error in displacement. Three specimens, 1 × 8 × .0415, cut from the Inconel sheet material were pulled in tension to verify the tensile properties. On the basis of the results it is concluded that, where linearity is important, design limits should be based on the 0.02 percent yield strength rather than the more commonly quoted 0.2 percent value. As seen from the load-strain diagram, the material in the condition tested will start yielding at a strain level of 4000 micro inches. (auth)

2621 (WANL-TMI-1697) THEORETICAL FORMULATION OF THE TUBULAR THERMOELECTRIC GENERATOR STRESS ANALYSIS PROGRAM. Soo, J. Y. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [1966]. 78p. Dep. NTIS $7.00.

The theoretical formulation of the stress analysis program for the tubular thermoelectric generator as revised in July, 1966 is presented. (auth)

2622 (WANL-TMI-1699) FAILURE MODE ANALYSIS REPORT ON CEC PRESSURE TRANSDUCER, WANL P/N 978D231H01, S/N A36264 FOR NRX-A5. McCullough, C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Aug 1966. 13p. Dep. NTIS $4.00.

After an electrical short was found in a check of a pressure transducer, the device was disassembled and examined. Probably it had been exposed to too much voltage (greater than 12 VDC), but the detective work was partially flawed by accidents during disassembly. (LTN)

2623 (WANL-TMI-1716) DIGITAL REDUCTION PACKAGE FOR VIDAR RECORDING SYSTEM BCD TAPE OUTPUT. Thomson, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Sep 1967. 5p. Dep. NTIS $4.00.

VIDCAL, VIDSRT, and VIDPLT are FORTRAN IV digital codes developed to calibrate and display information taken from BCD magnetic tape. These three codes make up a data reduction package for use with the VIDAR Digital Recording System. This system records NERVA component test data on BCD magnetic tapes that are used as data input to the VIDCAL/VIDSRT/VIDPLT package. The three codes execute separately and in a designated order, each routine serving a special purpose. The digital package requires punch card and BCD tape input, and produces printed paper and plots of reduced data. Many modes of calibration and output are available to the user to meet the specific needs of the test engineer. This package is designed to meet present data reduction requirements as well as provide the groundwork for more sophisticated codes as new data reduction needs arise and are defined. (auth)

2624 (WANL-TMI-1721) SURVEY OF DOSIMETRY FOR RADIATION EFFECTS TESTING AT PBRF AND NRDS. Rowland, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1966. 30p. Dep. NTIS $4.50.

An attempt has been made to indicate some of the problems associated with prior HT-1 dosimetry at the PBRF. A new neutron dosimetry package has been suggested for the W-1 capsule. Certain constants are also provided which will allow the old HT-1 dosimeter data to be corrected. (auth)

2625 (WANL-TMI-1761) NRX-A6 SHIELD FLOW SCREEN BURST TEST (EML-76). Thomson, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Mar 1967. 10p. Dep. NTIS $4.00.

Burst tests of NRX-A6 shield flow screens have been completed. Testing was conducted to determine the maximum pressure differential the screens could withstand without failure. The screens supplied had been rejected by Quality Control. The screens were tested in a special fixture. A simulated shield and screen retainer held the screens in position. A rubber membrane was laid across the screen to simulate a blocked screen condition. The assembly was tested in a burst chamber connected to the test apparatus. Helium gas pressures of 1, 5, 10 and 20 psid were imposed on the screens. After each pressure level had been maintained for a short period of time the screens were removed from the fixture and examined. Then, starting with 20 psid, the pressure differential was increased by 10 psi increments until the screens failed. Oval screen (no. 20) was instrumented with strain gauges positioned longitudinally on the screen hoop. Screens are shown after testing. All screens withstood low pressure testing without any visible damage other than slight screen deflection. (auth)

2626 (WANL-TMI-1815) NRX-A6 LATERAL SUPPORT SPRING TEMPERATURE-LOAD TEST. Andra, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Aug 1967. 9p. Dep. NTIS $4.00.

Temperature-load tests of the NRX-A6 lateral support spring have been completed. Testing was conducted to determine at what temperature the springs would take a set under a simulated design load. Four NRX-A6 reactor grade springs were tested. The springs tested at a uniform temperature of 1400°R took an excessive set while the set of the springs operated at 1250°R and lower was in the acceptable range. These results indicate a satisfactory spring design, as the maximum spring temperature anticipated in the NRX-A6 reactor is 1066°R. (auth)

2627 (WANL-TMI-1816) NRX-A6 DISPLACEMENT TRANSDUCER, RESONANT FREQUENCY INVESTIGATION. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Aug 1967. 7p. Dep. NTIS $4.00.

A displacement transducer developed for the NRX-A6 Reactor was subjected to a series of sweep and dwell vibration tests. The transducer is basically a cantilever beam with a strain gage mounted at the fixed end. Three transducers of this type were bolted to the reflector of the partial length core. Any relative motion between the core and reflector, will cause the strain gage to transmit a signal to the monitoring equipment. The purpose of the tests was to determine if a resonating condition would signal an erroneous displacement. The evaluation was made in the frequency range from 7 to 500 cps and at acceleration levels to 5 g's. Dwell tests were then performed at the resonant frequencies. The tests were repeated at selected preset displacement. The output signals from the control accelerometer and strain gage were recorded on an oscillograph. The transducer exhibited output signals at frequencies which were not dependent upon plunger pin position or acceleration levels. The tabular data indicates a frequency band of 40 cycles within which these outputs occurred. The apparent amplitude of the output signals varied with the input accelerations. Filters should be provided to eliminate the monitoring of erroneous signals. (auth)

2628 (WANL-TMI-1817) PROOF TESTING OF NRX-A6 CUPS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Jul 1967. 7p. Dep. NTIS $4.00.

The mechanical properties of cups intended for use in the NRX-A6 reactor were measured. With the exception of one test, all the results were favorable. Some cups were made of tungsten and some of a carbide composition. (LTN)

2629 (WANL-TMI-1845) CORE RADIAL DISPLACEMENT TRANSDUCER DESIGN EVALUATION REPORT. McCullough, C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Oct 1967. 19p. Dep. NTIS $4.00.

The evolution and capabilities of the Core Radial Displacement Transducer are documented. Pertinent details of the transducer history (Measurement Definition, Basic Design Equations and Evaluation Program) are included to substantiate the evolution. (auth)

2630 (WANL-TMI-1851) THERMAL SHOCK OF PDS 30182-2 GRAFOIL TO DETERMINE OUTGASSING EFFECTS. Malarky, J. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1967. 5p. Dep. NTIS $4.00.

Thermal shock tests on several layer thicknesses of Grafoil wrappers assembled with petrolatum showed destruction of the outer layer (by the force of the hot helium), but little bubbling of the foil and no case of catastrophic bubbling or cracking. (LTN)

2631 (WANL-TMI-1855) SIMULATED NRX-A6 LEAK CHECK AND TRANSPORTATION TESTS. Malarky, J. T.; Andra, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Nov 1967. 31p. Dep. NTIS $4.75.

Tests were conducted to determine the effects on NRX-A6 fuel elements when subjected to simulated NRX-A6 core leak check procedures and a transportation environment simulating the worst conditions generated during shipment of an assembled reactor. The specifications governing test procedures are shown. (auth)

2632 (WANL-TMI-1857) GAS IMPINGEMENT TESTING. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Dec 1967. 5p. Dep. NTIS $4.00.

Thermal shock produced by impinging very hot or very cold gas on NRX-A5 graphite supports resulted in cracks in the coatings when very severe temperature gradients were created. Damage to coatings was relatively easy to produce by impinging a cold gas on a corroded surface. (LTN)

2633 (WANL-TMI-1864) ROOM TEMPERATURE LOAD TEST. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jan 1968. 2p. Dep. NTIS $4.00.

2634 (WANL-TMI-1873) CORE WRAPPER AXIAL FLOW IMPEDANCE TESTS. Rostand, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Feb 1968. 14p. Dep. NTIS $4.00.

2635 (WANL-TMI-1883) FREAK: A COMPUTER PROGRAM TO PRODUCE A GAUSSIAN OPTICAL FREQUENCY SPECTRUM PLUS AN ACOUSTICAL DEBYE-LIKE BAND. Moran, L. L.; Johnson, A. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Feb 1968. 6p. Dep. NTIS $4.00.

The construction of moderator kernels for the B1T library requires a gas tackon for energies above 1 eV. The P1GAS program which produces the tackon is most accurate when an effective temperature is used. The program DETS calculates the effective temperatures for the moderators. DETS requires as input a frequency distribution. For several moderators a Gaussian optical spectrum with a Debye band has been used. (auth)

2636 (WANL-TMI-1893) INHOUSE FABRICATION OF THE XE-2 HIGH TEMPERATURE THERMOCOUPLES. Chambers, G. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 Apr 1968. 28p. Dep. NTIS $4.50.

Thermocouples of the WANL 978D270H02 design previously built for Nerva Reactor core temperature measurements had shown a marked reduction in output voltage at elevated temperatures. This undesirable characteristic was believed to be due to impurities in the thermocouple material or picked up during assembly or, most probably, a combination of both. It was planned to improve the thermocouple performance by using higher purity materials and requiring stringent cleanliness controls during assembly. Thermocouple materials were purchased to upgrade specifications which limited the impurity content. The most significant change was in ordering molybdenum tubing produced by vapor-deposition rather than by drawing. Metal parts were initially cleaned by controlled mechanical and/or chemical processes. Contaminants were driven from ceramic parts before use by torch heating the pieces to a specified temperature for a fixed time. Thermocouple assembly took place in an area where cleanliness was maintained. Contamination during assembly was minimized through use of clean, lint-free gloves. Brazing and welding operations were performed in an inert atmosphere, low in impurities. The problems encountered were generally due to the fact that this was a first-time production effort for the fabrication of reactor grade thermocouples containing fragile, vapor-deposited, molybdenum sheathing. Molybdenum breakage has held at a minimum by incorporating specially devised fixtures for assembly, handling and shipping operations. Typically, as the technicians gained experience, the discrepancies and work time were greatly reduced. Representative thermocouples were qualification tested upon completion of fabrication and were found to have a relatively better accuracy at elevated temperatures than any previously tested thermocouples of this type. (auth)

2637 (WANL-TMI-1894) R-1 POISON WIRE DEVELOPMENT TESTS: ELONGATION TEST AND YIELD TEST. Sucevic, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Apr 1968. 13p. Dep. NTIS $4.00.

2638 (WANL-TMI-1901) TENSILE STRENGTH OF GEM AND GED COATED FUEL ELEMENTS. Brickman, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Apr 1968. 2p. Dep. NTIS $4.00.

Tension tests were performed on ten-inch long sections of GEM and GED coated elements at room temperature in a short bundling test fixture. A description of the test fixture and its operation can be found in WANL-TME-1555 and WANL-TMI-1707. The GEM coated elements failed at strains slightly in excess of 2000 microstrain; the GED coated elements did not fail at strains of 4000 microstrain. The results are tabulated. Testing was not continued beyond the 4000 microstrain level. In an attempt to apply higher axial loads on the bundling elements, which in turn would impose greater strain on the specimen, several of the bundling elements failed; and the test was stopped. (auth)

2639 (WANL-TMI-1910) MODIFICATIONS IN THE HYDROGEN GAS SUPPLY FOR LOW TEMPERATURE OPERATION. DeZubay, E. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 May 1968. 9p. Dep. NTIS $4.00.

The possibilities of slightly modifying the gas resources available both at WANL and WANHES so that low temperature gas can be provided to the test cells for experiments with tie tube clusters and with fuel elements are considered. Low temperature gas is defined in the range from 40°R to 200°R. The proposed modifications would provide a low cost source of low temperature gas quickly and easily in time for significant experiments on R-1 cluster and fuel element tests. Furthermore, these schemes utilize any overage of gas used for chill-down of the transfer lines from the pump to the test cells by returning this gas through standardized and existing equipment to the storage bank. The flow rates will be sufficient to supply full flow for single fuel element tests up to 0.1 pps (1200 SCFM) and for the separate flow required in stem type clusters. The main flow in the clusters will still require ambient gas. (auth)

2640 (WANL-TMI-1912) CURING OF RTV-891 SILASTIC ORIFICE CEMENT. Rymer, G. T.; Manges, R. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1968. 25p. Dep. NTIS $4.25.

Examination of the XE-1 reactor after several months storage in its shipping container revealed the presence of a fine debris within the reactor. The presence of this debris consisting of graphite, uranium fuel beads, and NbC was attributed to hydrolysis of the UC_2 fuel at the surface of coolant channels in the fuel elements. It was postulated that UC_2, upon hydrolysis would undergo a change in crystal structure accompanied by fuel bead swelling which could dislodge NbC coolant channel lining, resulting in a fine debris. Although this mechanism is possible, the question arises as to why similar behavior did not occur with fuel elements stored for much longer times in apparently similar environment. One possibility is that some agent present in the assembled reactor but absent in shelf stored fuel, sensitized or catalyzed the hydrolysis reaction. Silastic RTV-891 adhesive is used to cement stainless steel orifices in fuel element coolant channels during assembly of NRX and XE reactors. This Silastic adhesive cures by a polymerization process during which acetic acid is liberated. Although no relationship has been established between acetic acid and UC_2 hydrolysis, it was thought prudent to minimize acetic acid contamination of the fuel elements during assembly of the XE-2 reactor. A series of experiments on the curing of the adhesive showed that 3.2 percent of the adhesive weight was lost, presumably as acetic acid. Curing is complete in 65 hours, but the initial curing rate depends on relative humidity and air flow. (auth)

2641 (WANL-TMI-1914) CONTROL DRUM SCRAM TEST FOR XE-1 REVIEW. Miselis, V. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jun 1968. 12p. Dep. NTIS $4.00.

The purpose of this test is to determine the failure mode of the control drum assembly as a result of scrams performed at ambient and cryogenic temperatures. The test arrangement consisted of control drum, hard stop and simulated soft stop. A cantilever beam was used as a soft stop to reduce the angular velocity of the drum at 15 degrees prior to impact against the hard stop. The spring rate of the cantilever beam was 2650 in-lb per radian, compared to the actual soft stop value of 2580 in-lb per radian. The scram spring torque at 15 degrees was 5.4 ft. lbs. A transducer attached to the aft end of the control drum was used to record angular displacements as the system was scrammed from various angles. The test setup did not consider the effects of the actuator system during scram, but the results are an indication of the structural adequacy of the hardware. It is concluded that, in the ambient temperature test, the dome end bearing shaft continued to yield after the 165 degree scram and failure occurred after the shaft had twisted nine degrees at a scram from 180 degrees. In the cryogenic temperature test (−320°F) an unused dome end bearing shaft was subjected to 98 scrams. Forty-eight of these were from positions of 180 degrees and higher. An inspection after testing showed the total twist of the shaft was seven degrees twenty-five minutes. Therefore, the shaft can absorb energy without fracture at cryogenic temperatures. (auth)

2642 (WANL-TMI-1920) XE CALORIMETER SUPPORT VIBRATION TEST. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Aug 1968. 11p. Dep. NTIS $4.00.

The support bracket with a calorimeter attached was bolted to a base plate and vibrated in three mutually perpendicular axes. Strain gages were used to monitor strains at critical locations on the calorimeter and support bracket. The output of the strain gages, control accelerometer and frequency of vibration were recorded on an oscillograph. Exploratory and resonance dwell tests were conducted for a total elapsed time of 60 minutes. Major resonances occurred at 48,488 and 509 Hz. The support bracket was not damaged. The calorimeter developed cracks but remained intact. (LTN)

2643 (WANL-TMI-1929) XE CALORIMETER SUPPORT ALTERNATE DESIGN VIBRATION TEST. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Aug 1968. 5p. Dep. NTIS $4.00.

Tests at ambient conditions were performed to determine the ability of an alternate design of a calorimeter support to survive a vibration loading. The calorimeter support with a calorimeter attached was bolted to a fixture plate and vibrated along three mutually perpendicular axes. Exploratory, investigative and resonance dwell tests were conducted for a total elapsed time of 100 minutes. The exploratory tests were of three minutes duration in each of the three directions, and the investigative tests were seven minute sweeps over the frequency range from five cps to 1000 cps. Ten strain gages were used to monitor the strains at critical locations on the calorimeter support and the calorimeter. A summary of the resonance frequencies and the maximum strains are shown. The calorimeter support was not damaged and the entire assembly remained intact. (auth)

2644 (WANL-TMI-1930) POISON WIRE RETAINER PULL TEST. Sucevic, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Aug 1968. 5p. Dep. NTIS $4.00.

Two series of tension tests were performed on a candidate poison wire retainer mechanism. A photograph of the test setup is shown. In the first arrangement, the forces required to detach the retainer from the cluster hardware was determined. This scheme is one of the primary candidate designs being considered. Forces between 2.10 and 2.15 lb were required to disengage the coupling. Forces on the plunger, compress the spring, which in turn releases the ball detent, separating the retainer from the end fitting on the stem protective cap. The second series of tests were performed to determine the forces required to separate the retainer body from the end fitting without operating the detent mechanism in the normal manner. In this case the detaching forces which were required varied from 5.12 to 5.6 lbs. The dead weight of the plunger-retainer body section is .05 lbs. (auth)

2645 (WANL-TMI-1933) SHIELD ELEMENT THERMAL SHOCK TEST. Morgan, L. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Sep 1968. 2p. Dep. NTIS $4.00.

A shield element specimen was tested to determine whether possible striae cracking of the shield would occur during reactor startup or other severe thermal shock conditions. The specimen was reactor grade material $^{15}/_{16}$ inches in diameter and 11-$^{1}/_{2}$ inches long. The test was performed by mounting the specimen in a holder that directed a flow of high pressure cryogenic gaseous helium at 150°R temperature into a small annulus formed by the outside surface of the specimen and inside surface of the holder. The annulus flow passage was representative in size to that anticipated in the reactor design. Instantaneous chilling of the specimen was obtained by use of a gas diverting system. The required gas flow rate was determined by an orifice flow meter while the cold gas was flowing through the calibrated flow resistance. Then the flow was diverted through the holder with the specimen by simultaneous closing the valve connected to the calibrated flow resistance and opening the valve connected to the holder with the specimen. Visual inspection revealed that the thermal shock did not damage the specimen. (auth)

2646 (WANL-TMI-1935) FORWARD END CEMENTING DEVELOPMENT. Brickman, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Sep 1968. 5p. Dep. NTIS $4.00.

The results of a fuel cluster cementing program are reported. EPY-500 Epoxy cement was cured for 4 hours and tested at different temperatures. The strength decreased rapidly as the temperature was increased. (LTN)

2647 (WANL-TMI-1937) XE-2 GAMMA RATE SENSOR VIBRATION TEST. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Sep 1968. 5p Dep. NTIS $4.00.

Tests were conducted at ambient conditions to evaluate the structural integrity of the XE-2 gamma rate sensor and mounting brackets. The gamma rate sensor and its mounting brackets were fastened to a fixture plate and vibrated along three mutually perpendicular axes. Exploratory, investigative, and resonance dwell tests were conducted for a total elapsed time of 60 minutes. The recorded data included the output signals from four strain gages mounted on the mounting brackets, the control accelerations and the vibration frequencies. A visual inspection at the conclusion of testing indicated that there was no apparent damage to the gamma rate sensor or its mounting brackets. (auth)

2648 (WANL-TMI-1964) XE-PRIME FAST NEUTRON DETECTOR VIBRATION TEST. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Feb 1969. 7p. Dep. NTIS $4.00.

Tests were conducted on XE-Prime Fast Neutron Detectors at ambient conditions to determine if any abnormal effects resulted due to the dynamic environment anticipated during service on the dome end of the XE-Prime Reactor. A spare detector, Serial Number A85384, was attached to the vibration table and subjected to sinusoidal acceleration inputs along three mutually perpendicular axes. The vibration test consisted of a seven minute sweep through the spectrum. A typical test set-up for the detectors and the instrumentation for monitoring the detector output signals are shown. A second vibration test was conducted to determine if an erroneous signal was caused by the detector connector and lead. The connector and lead were vibrated in the lateral direction through the spectrum shown. No abnormal signal was observed. Two other detectors, Serial Numbers A85385 and A85386, and one preamplifier unit, Serial Number A85297, were also vibration tested. An evaluation of the test data is being conducted to determine the magnitudes of the detector output signals due to vibration and what effect these extraneous outputs will have on the real data output. (auth)

2649 (WANL-TMI-1969) RELIABILITY ANALYSIS OF NERVA ACTUATOR/CONTROL DRUM SYSTEM. Spezialetti, I. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Mar 1969. 11p. Dep. NTIS $4.00.

The problem solved is that, given the reliability goal for the Actuator/Control Drum System, to determine the reliability goal requirements for each Actuator/Control Drum Unit within the system, and to apportion the reliability goal requirements for the major components within each Actuator/Control Drum Unit. This is done for a few examples. (LTN)

2650 (WANL-TMI-1978) PROBLEM OF HYDROLYSIS IN NERVA FUEL. Roesmer, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Apr 1969. 14p. Dep. NTIS $4.00.

The debris from the XE-1 reactor, consisting of graphite, UC_2 beads, and flakes of NbC illustrates well the mechanical effects of hydrolysis. During the hydrolysis reaction, UC_2 which has a CaC_2-type lattice and a density of 11.8 grams/cc, changes into UO_2 which has a face-centered fluorite (CaF_2) lattice and a density of 10.9 grams/cc. The lower density of the hydrolysis product leads to an expansion of UO_2 which in turn sets up stresses in the matrix. Such stresses lead to cracks in the matrix, to cracks in the pyrocarbon coating of other, intact, beads, and to a partial lifting of NbC flakes. Hydrolysis might well be considered to be the most significant step in hydrogen corrosion of fuel. As a result of the experience with XE-PRIME fuel element hydrolysis, extensive experiments were conducted to study the chemistry of uranium carbide hydrolysis, to investigate certain fabrication steps in which traces of acid could be formed and to develop fuel storage procedures which would prevent or minimize the progress of hydrolysis, e.g., storage with desiccants. Further studies are recommended. (auth)

2651 (WANL-TMI-2003) XE-PRIME XENON MEASUREMENTS. Chapter E. XE-Prime Test Analysis Report. Ortenberg, L. I.; Mowery, A. L.; Rittenberger, R. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1970. 15p. Dep. NTIS $4.00.

The ability to restart a nuclear reactor at some time following powered operation is dependent in part on the reactivity worth of the fission product inventory at the time of restart. Since it may be necessary to provide a reactor design capable of restart under certain adverse conditions resulting from fission product effects, it is important to know the magnitude of the reactivity effect that can be expected. With this goal, then, the objective of the tests described was to determine experimentally the reactivity effect of the fission product inventory as it varied during the shutdown period following a power test. The tests were conducted in EP-5C (6/11/69) and EP-4A (6/26/69) in an attempt to map the fission product reactivity worth from the power test performed in EP-5C. The expected reactivity effect of xenon-135 and the measured fission product reactivity effects are presented. (auth)

2652 (WANL-TNP-044) NUCLEAR ROCKET ENGINE DYNAMICS STUDY. Blake, P. J.; Esselman, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Oct 1961. 20p. Dep. NTIS $4.00.

Start-up studies are reported considering first just the negative temperature coefficient of reactivity associated with the fuel temperature, and second, just the positive density coefficient of reactivity associated with the hydrogen density in a control region. Preliminary results are given of a non-simultaneous digital-analog study of start-up which utilizes a detailed digital code description of heat transfer and fluid dynamics, and an analog description of reactor kinetics and controls. Thrust maneuvering capabilities are explored and used as a basis for comparing control designs. Both fast and slow controllers capable of maintaining propellant exit temperature with ±50°R are discussed. (auth)

2653 (WANL-TNR-088(Rev.F)) NERVA NUCLEAR SUBSYSTEM PRODUCT ASSURANCE PROGRAM PLAN. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 May 1968. 51p. Dep. NTIS $5.75.

The successful achievement of the reliability objectives depends upon many operations, from design through procurement, fabrication, shipment, installation, and checkout on the nuclear subsystem—as well as on instrumentation, ground support equipment, test facilities and equipment. In view of the many detailed steps which must be performed, the objectives can be met only if every member of the NERVA Project is acutely aware of the need for attention to detail and is continually on the alert for any item which might compromise the achievement of the objectives. The basic responsibility for achieving the necessary reliability in the NERVA Nuclear Subsystem rests with the designer. The reliability goal can be obtained only by the incorporation of the mechanical, thermal, nuclear, and mission reliability requirements into the engineering drawings and specifications; and these supported by appropriate analysis or component testing. Primary emphasis will be placed on detecting and correcting actual or potential problems early in the program. The Reliability Program will provide for a formalized, systematic effort to insure that all problems are identified through failure mode analyses, design reviews, and failure reporting; and that they are carried as open items until corrected. The basic responsibility for maintaining quality, or minimizing any degradation from the maximum possible reliability inherent in the design rests with the fabricators, assemblers, and testers. The Quality Control Program provides a planned, systematic effort in all program phases to assure that high quality is planned for and achieved, and that objective evidence of quality conformance is maintained. (auth)

2654 (WANL-TNR-099(Add.)) SAFETY REPORT FOR THE WESTINGHOUSE ASTRONUCLEAR EXPERIMENTAL FACILITY. Frantz, F. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1966. 9p. Dep. NTIS $4.00.

An auxiliary shutdown system has been designed and constructed for use on the PAX reactor. The mechanism is designed to provide a "last ditch" reactor shutdown capability by inserting nuclear poison worth at least $1 in reactivity, thereby cancelling the positive reactivity insertion associated with the maximum credible accident in the PAX (i.e., a one-drum rollout accident). It is not intended that this system be interlocked to provide an additional automatic scram; rather, it will be manually actuated from the control room if the need exists. The time necessary to insert the auxiliary poison will be on the order of a minute, in contrast to the automatic shutdown system (control drums) which takes less than one second. (auth)

2655 (WANL-TNR-102) TRANSIENT TWO-PHASE HEAT TRANSFER AND FLOW CHARACTERISTICS OF LIQUID HYDROGEN Campi, F. A.; Chi, J. W. H.; DeZubay, E. A.; Holmgren, J. D.; Vetere, A. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1963. 81p. Dep. NTIS $7.25.

Initial results of a program to evaluate transient two-phase heat transfer and flow characteristics of hydrogen as an integral part of the NERVA reactor requirement are summarized. To carry out these studies, a hydrogen facility and cryogenic laboratory was built and experiments were performed to obtain the desired data. The experimental program included studies of single phase heat transfer, two-phase flow, and forced convection transient boiling heat transfer. The investigations were made with cold gaseous and liquid hydrogen flowing through horizontal test sections over the following range of conditions; inlet pressure

15 to 45 pounds per square inch absolute, flow rate 0.001 to 0.005 pounds per second, and temperature differentials of 10 to 500°R between the fluid and the wall. Two different test sections were used: a thin-walled copper tube (3/16" I. D. × 1/4" O. D.) and a heavier walled aluminum tube (3/16" I. D. × 1" O. D.). Cool-down temperature, cool-down time, single phase heat transfer coefficients, transient two-phase flow characteristics and two-phase heat transfer coefficients are presented. Based on the transient fluid temperature data obtained, it is shown that, in the film boiling and transitional regimes; thermodynamic equilibrium cannot exist between the vapor and the liquid. The mechanisms of two-phase flow during cool-down are discussed in detail and a two-phase flow model postulated. The model provides a simple method for the determination of vapor fractions from temperature traces; a knowledge of the vapor fractions is a prerequisite for the understanding and prediction of two-phase heat transfer. (auth)

2656 (WANL-TNR-133(Rev.)) VARI-QUIR: A TWO-DIMENSIONAL TIME-DEPENDENT MULTI-GROUP DIFFUSION CODE. Riese, J. W.; Collier, G.; Rieck, C. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 201p. Dep. NTIS $13.25.

A variational approximation is developed to solve the time-dependent neutron diffusion equations. The method is incorporated into a computer code, which allows up to 4 energy groups and 6 precursors. Some sample results are presented. This report represents an updating and expansion of WANL-TNR-133. The principle changes include modifications of the input-preparation instructions, the inclusion of a listing of the revised code and a detailed sample problem printout, a discussion of this printout, and a discussion of improvements in the neutronics code. (auth)

2657 (WANL-TNR-189) VARI-QUIR III: A TWO-DIMENSIONAL STEADY STATE MULTI-GROUP DIFFUSION CODE. Collier, G.; Riese, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1964. 74p. Dep. NTIS $6.75.

A variational approximation is developed for the steady state neutron diffusion equations. The method is incorporated into a computer code, which allows up to 18 energy groups and 23 different-material regions. The code can handle problems with X−Y and R−Z geometries. An R−Θ version of the code is being written and the equations for R−Θ geometry are also given. (auth)

2658 (WANL-TNR-225) NERVA TECHNOLOGY REACTOR INTEGRATED WITH NASA LEWIS BRAYTON CYCLE SPACE POWER SYSTEMS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1970. 138p. Dep. NTIS $10.00.

The NERVA Technology Reactor, which has been under study at the Westinghouse Astronuclear Laboratory since 1966, has been redesigned to permit direct integration with the NASA Lewis Brayton cycle power systems. This reactor utilizes proven design concepts and design methods developed in the NERVA program and in the fuel development effort for application to commercial power reactors. All reactor design features are considered to be present state-of-the-art. Other major advantages of this reactor are the high temperature capability, which far exceeds the future temperature capability anticipated for this power conversion equipment, and the flexibility for application to power conversion systems requiring different thermal levels of up to 2200 KW at different inlet and exit gas conditions. The fission gas retention in the millions of fuel particles is sifficiently low to allow a direct inert gas cycle without sacrificing maintainability of the power conversion unit following a shutdown period. The Lewis Brayton Cycle power conversion units are of two sizes: a 2−15 KW(e) unit, which is in an advanced state of development, weighing 1376 lbs (without radiator) and having an envelope of 33 × 55 × 69 inches, and a second unit under initial development at Lewis which will be capable of 60−140 MW(e). A cycle efficiency of 23 percent can be obtained with either conversion system with a reactor outlet temperature of 2060°R; however, higher efficiencies can be obtained at the expense of a larger space radiator. A reactor design power of 2.2 MW, inlet temperature of 1621°R, outlet temperature of 2060°R, inlet pressure of 228 psia, and coolant of molecular weight of 39.9 were selected. This NERVA Technology Reactor, when used with various combinations of the Lewis Brayton power conversion systems at 23% efficiency, can provide outputs from 25 to 506 KW(e) for 50,000 hours. (auth)

2659 (WANL-TR-6550) TRIP TO WESTINGHOUSE INDUSTRIAL EQUIPMENT DIVISION, SYKESVILLE, MARYLAND. Pahler, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Nov 1970. 2p. Dep. NTIS $4.00.

Following unsuccessful attempts to clean the Core Support/Plena Plate, it was taken to another company division, which had high capacity ultrasonic cleaning equipment. This method was not satisfactory for removing minute particles trapped in the complex network of holes in the plates. Additional in-house cleaning was planned to clean each hole individually in a clean room. (LTN)

2660 (WANL-TR-6553) TRIP TO LOS ALAMOS, NEW MEXICO. Salvador, L. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Nov 1970. 4p. Dep. NTIS $4.00.

The elimination of bowing in high temperature furnace tests of fuel elements has been accomplished with the aid of one or two supports. A gradual temperature change is regarded as less damaging than step change ramps. Chuck development is discussed. (LTN)

2661 (WANL-TR-6590) TRIP REPORT TO LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO. Kovacik, W. P.; Bevard, D. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jan 1971. 4p. Dep. NTIS $4.00.

Information was obtained on new composite fuel elements and results of tests of these and normal fuel elements in the PARKA critical assembly. These new fuel elements are to be tested at WANEF in the PAX-G4 critical configuration. Also, measurements of the reactivity worth of zirconium were made (the new composite fuel elements contain zirconium). The composite fuel is in the development stage and, at this point, is "deity", requiring vacuum systems to prevent the spread of contamination. (LTN)

2662 (WANL-TR-6640) TRIP REPORT TO GENERAL DYNAMICS, FORT WORTH, TEXAS. Albertin, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 May 1971. 2p. Dep. NTIS $4.00.

Copper-boron-10 and copper-boron-natural composites were tested in the form of 2-inch wide center-crack sheet specimens to determine the effect of radiation damage on the crack damage parameter K. The specimens were irradiated to fluence levels of 8×10^{17} and 8×10^{18} n/cm², (E > 1 MeV) and were subsequently tested in a rising load test at −320°, 75°, and 480°F to evaluate fracture toughness. Preliminary test results indicate that the damage parameter K at the point of crack initiation is more than twice as high after irradiation than the parameter for the unirradiated condition. A slight decrease in the crack damage parameter, K, due to annealing at 480°F was noted. The increase in the crack initiation damage parameter, K, in irradiated specimens is the result of a large increase in the gross fracture strength due to irradiation damage. Irradiated specimens fractured in a brittle manner with little slow crack growth as compared to unirradiated specimens. The latter generally showed substantial slow crack growth and stable fractures. (auth)

2663 (WANL-TR-6655) TRIP REPORT TO LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO. Holman, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Jun 1971. 8p. Dep. NTIS $4.00.

A number of topics dealing with fuel elements, ZrC insulators, thermal stresses, thermal conductivity measurements, etc. were discussed at a nuclear furnace review meeting. (LTN)

2664 (WANL-TR-6658) TRIP REPORT TO SOUTHERN RESEARCH INSTITUTE, BIRMINGHAM, ALABAMA AND OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE. Zemanick, P. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jul 1971. 13p. Dep. NTIS $4.00.

WANL representatives visited the laboratories to study the work being done on graphite, particularly on methods of measuring the mechanical properties, effects of thermal stresses, and theories of graphite behavior. The discussions also involved the properties of carbide coatings on NERVA graphite fuel elements. (LTN)

2665 CORE INSPECTION PROGRAM AND MAINTENANCE ON REACTOR INTERNALS AT THE MH-1A. Turovlin, B.; Hum, M. R. Trans. Amer. Nucl. Soc.; 20: 174-176(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2666 NUCLEAR SHIP PROPULSION. Ulken, D.; Harde, R.; Schroeder, F. Trans. Amer. Nucl. Soc.; 20: 791(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2667 NAVAL NUCLEAR PROPULSION PROGRAM, 1974. Hearing Before the Joint Committee on Atomic Energy Congress of the United States, Ninety-Third Congress, Second Session, February 25, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 84p. GPO $1.10.

Reactor Safety and Environmental Aspects

Refer also to abstracts 742, 747–749, 2729, and 2909.

2668 (AED-CONF-74-570-001) SAFETY-TECHNICAL ASSESSMENT OF FAULTY WELDED JOINTS OF REACTOR COMPONENTS. Bartholome, G.; Vasoukis, G. (Kraftwerk Union A.G., Erlangen (F.R. Germany)). 1974. 12p. (In German). INIS.

From VGB conference on materials and welding techniques in power plants, VGB materials conference; Duesseldorf, F.R. Germany (26 Nov 1974).

12 figs.; 11 refs. With abstract.

Data on permissible faults in service inspection of reactor components are connected with experience values and with the state of development and use of nondestructive testing methods. Should the detected fault exceed these values, these faults must be assessed. The safety margin for operations, accidents, and emergencies can be mechanically measured. This is shown using the example of the welded joint of a reactor pressure vessel. (GE)

2669 (AED-CONF-74-583-001) RELIABILITY STUDIES FOR CONTROLLED PRESSURE PROTECTION ARMATURES. Mai, E.; Eggert, H. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany)). 1974. 13p. (In German). INIS.

From symposium power plant engineering. Reliability enhancement and operation optimization; Bad Neuenahr, F. R. Germany (7 Oct 1974).

With abstract. Available from ZAED.

Firstly the failure effect and the fault tree analysis are presented. By means of examples taken from the safety technical guide for safety valves, the reliability of relay-operated safety equipment against excess pressure with any sealing capacity is determined. Of particular interest are: redundance of the control lines, the number of main valves; and comparison of the relief with the loading principle as well as the working principle and the influence of the testing times. Finally, the possibility of a 2-out-of-3 switch on the control side is investigated. (GE)

2670 (AED-CONF-74-585-001) SITES OF POWER PLANTS. Kuhlmann, A. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany)). 1974. 19p. (In German). INIS.

From lecture meeting on energy and environment; Duesseldorf, F. R. Germany (5 Dec 1974).

Site selection for nuclear power plants is difficult due to the many requirements, and must be based on very careful optimization calculations. All justified safety and environmental protection requirements can be technically fulfilled by both conventional and nuclear power plants. The site selection problem in thickly or thinly populated areas is primarily one of economics for the operator. To deal with the problem in any other way leads to emotion and speculation (nuclear controversy) and thus evades the real issues. The Rasmussen study (WASH-1400) can not be quoted in the discussion on suitable sites for nuclear power plants in the FRG. An estimate of the overall accident probability is suggested which follows the WASH-1400 only with regard to the reactor types (BWR and PWR) and the release categories. There is an occurrence probability of very serious accidents of 10^{-7} per reactor and per year with a danger limiting value of 10^{-5} deaths per person and year for a single large plant. (GE)

2671 (ANCR-1194) EXPERIMENT DATE REPORT FOR SEMISCALE MOD-1 TEST S-01-2 (ISOTHERMAL BLOWDOWN WITH CORE RESISTANCE SIMULATOR). Zender, S. N. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Feb 1975. Contract AT(10-1)-1375. 197p. Dep. NTIS $7.60.

Recorded test data are presented for Test S-01-2 of the semiscale Mod-1 isothermal blowdown test series. Test S-01-2 is one of several semiscale Mod-1 experiments which are counterparts of the LOFT nonnuclear experiments. System hardware is of the LOFT design selected using volumetric scaling methods, and initial conditions duplicate those identified for LOFT. Test S-01-2 employed an intact loop resistance that was high relative to that of other tests in the series to establish the importance of intact loop resistance on system response during blowdown. An orificed structure was used in the pressure vessel to duplicate the LOFT core simulator. The test was initiated at initial isothermal conditions of 2230 psig and 538°F by a simulated offset shear of the cold leg broken loop piping. After system depressurization, coolant was injected into the cold leg of the operating loop to investigate the hot wall effect on ECC delivery to the lower plenum. The purpose of this report is to make available the uninterpreted data from Test S-01-2 and to provide the reference material needed for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent. (auth)

2672 (ANCR-1195) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-01-3 (ISOTHERMAL BLOWDOWN WITH CORE RESISTANCE SIMULATOR). Zender, S. N. (Aerojet Nuclear Co , Idaho Falls, Idaho (USA)). Mar 1975. Contract AT(10-1)-1375. 154p. Dep. NTIS $7.60.

Recorded test data are presented for Test S-01-3 of the semiscale Mod-1 isothermal blowdown test series. Test S-01-3 is one of several semiscale Mod-1 experiments which are counterparts of the planned Loss-of-Fluid Test (LOFT) nonnuclear experiments. System hardware is of the LOFT design, selected using volumetric scaling methods, and initial conditions duplicate those identified for the LOFT nonnuclear tests. Test S-01-3 employed an intact loop resistance that was low relative to that of the first test in the series (Test S-01-2) to establish the importance of intact loop resistance on system response during blowdown. An orificed structure was used in the pressure vessel to simulate the LOFT core simulator. The test was initiated at isothermal conditions of 2245 psig and 538°F by a simulated offset shear of the cold-leg broken loop piping. During system depressurization, coolant was injected into the lower plenum of the pressure vessel to provide data on the effects of emergency core cooling on system response. Additionally, to aid in determination of the effects of accumulator gas on pressure suppression system response, the nitrogen used to charge the accumulator systems for Test S-01-03 was allowed to vent into the lower plenum following depletion of the coolant. (auth)

2673 (ANL-75-12) POST-ACCIDENT HEAT REMOVAL: LARGE-SCALE MOLTEN-FUEL-SODIUM INTERACTION EXPERIMENTS. Johnson, T. R.; Pavlik, J. R.; Baker, L. Jr. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-Eng-38. 37p. Dep. NTIS $4.00.

Kilogram-scale interactions between molten UO_2 and sodium were performed in an unrestrained geometry to study the resulting energetics and fragmentation. The molten UO_2 was produced by the exothermic reaction between uranium and MoO_3 powders. Under the conditions of the experiments completed to date, the short-rise-time pressure pulses created in the liquid phase had negligible work potential, and their magnitude did not increase with the amount of molten fuel. No significant gas-phase shock pressures were generated. The largest potential for mechanical work was the sodium vapor generated over a period of roughly 1 sec. About 20 percent of the heat was effective in generating vapor. The experimental results show a marked tendency of molten UO_2 to form particulate after passage through only a few inches of sodium. Particle size distributions obtained under the conditions of the experiments were not significantly different from those obtained in prior small-scale tests and in TREAT tests. Also, the results indicate that the metallic component of the molten mixture formed larger particles than the oxide component. (auth)

2674 (ANL-75-15) REXCO-HT: A HYDRODYNAMIC CONTAINMENT CODE INCLUDING MOLTEN-FUEL-COOLANT INTERACTIONS. Bratis, J. C.; Marciniak, T. J.; Gvildys, J. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-Eng-38. 69p. AT.

Evaluation of the response of the primary containment of Liquid Metal Fast Breeder Reactors (LMFBR) to hypothetical core-disruptive accidents (HCDA) has been a primary goal of the REXCO series of containment codes. In order to describe the source terms more realistically in the context of the reactor core state at the end of the nuclear-burst phase, heat-transfer models describing certain specific phenomena had been previously incorporated into the REXCO-H code. In the present work, more sophisticated fuel-coolant interaction models and a thermodynamically consistent equation of state for sodium are introduced into the REXCO-H code. These are first presented, followed by detailed information of the required input. Next, a description of the output formats and the limitations of the code are given. Finally, results obtained through application of the code to three different configurations are presented. 13 references. (auth)

2675 (BAW-10003(Rev.4)) QUALIFICATION TESTING OF PROTECTION SYSTEM INSTRUMENTATION. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Apr 1975. 22p. Dep. NTIS $4.25.

Protection system instrumentation is used in Babcock and Wilcox nuclear steam systems to initiate protective functions. The instrumentation includes the nuclear instrumentation and reactor protection system (NI/RPS) and the safety features actuation system (SFAS). Safety-oriented instrumentation must be very reliable, and qualification testing is required to verify that the design of the protective system equipment meets this requirement.

The qualification testing was conducted in six phases: (1) System electronic module performance tests; (2) Remote sensor performance tests; (3) Long-term operational tests of the nuclear flux channels of the NI/RPS at an operational reactor; (4) Environmental tests of all system modules and components; (5) Seismic tests on all system modules and components; and (6) Failure analysis of the coincidence logic modules. The results of these tests are summarized as follows: (1) All of the system's electronic modules meet or exceed all of their design requirements for electronic performance for both normal (reference) operating conditions and for the entire design range of power supply, environmental, and seismic conditions. (2) All other system components, including all remote sensors, meet or exceed all of their design performance requirements for normal operating conditions and for the entire design range of environmental and seismic conditions. (3) The nuclear instrumentation system performed as required for one year at an operating reactor. (4) Any single failure of the coincidence logic modules will not prevent a required protective action, nor will it result in a false protective action. The failure would be detectable by normal operational testing. (auth)

2676 (BMI-1932) ANALYTIC STUDIES OF AEROSOL BEHAVIOR PREDICTIONS FOR FAST REACTOR SAFETY. Gieseke, J. A.; Behn, R. C.; Chace, A. S.; Reed, L. D. (Battelle Columbus Labs., Ohio (USA)). 18 Mar 1975. Contract W-7405-eng-92. 263p. Dep. NTIS $7.60.

A critical step in safety analyses for liquid metal fast breeder reactors is the prediction of concentration for radioactive materials airborne in the containment vessels at various times after postulated accidents. Since much of the airborne radioactivity is expected to be associated with nongaseous species, the concentration-time behavior must be predicted with aerosol behavior models. The objective of this study was to compile, compare and evaluate available data applicable to analysis of aerosol behavior for fast reactor safety; to improve the currently available aerosol behavior models; to establish assumptions for use with improved models which will give consistently conservative predictions of airborne aerosol concentrations; and to recommend future research needs. The initial efforts were concerned with the selection of a set of assumed accidents and accident conditions for use as guidelines in the selection of conditions to be used in sensitivity analyses. The sensitivity analyses were performed primarily with the currently available HAA-3 code as developed by Atomics International. Sensitivity analyses were performed to determine the effects of assumed accident conditions and model details on predicted airborne aerosol concentration. The range of conditions included those found to represent reported experimental studies and those postulated to represent a typical LMFBR. A major finding was that for cases in which the mass release of aerosol material was postulated such that particle agglomeration was significant, there was almost no effect on airborne concentration of the assumed initial particle size. Comparisons among the compiled experimental data and between the data and the predictive models indicated that the effects of containment size and shape are least adequately known or predicted. It is believed that the aerosol behavior models can be further improved by including more realistic representations of particle collisions and agglomerate properties. However, it is also recommended that experiments be performed to clarify the effects of vessel size and shape on airborne particle concentrations. (auth)

2677 (COO-2294-5) TECHNICAL ASSESSMENT OF TWO-PHASE FLOW ASPECTS OF NUCLEAR REACTOR SAFETY. Progress Report, July 1, 1974-March 27, 1975. Wallis, G. B. (Dartmouth Coll., Hanover, N.H. (USA). Thayer School of Engineering). Mar 1975. Contract AT(11-1)-2294. 9p. Dep. NTIS $4.00.

Information is presented concerning steam–water interaction in a scaled PWR downcomer annulus, hot wall effect in a loss-of-coolant accident, and annular bypass problems in PWR. (DCC)

2678 (COO-2507-1) TORNADO PARAMETERS FOR NUCLEAR POWER PLANTS. Quarterly Report, November 30, 1974–February 28, 1975. Fujita, T. T. (Chicago Univ., Ill. (USA)). 1975. Contract AT(11-1)-2507. 2p. Dep. NTIS $4.00.

Progress in the compiling and plotting of tornado data is briefly summarized. (JWR)

2679 (EPRI-SR-8) DATA REDUCTION BY AN APPROXIMATE THERMAL DIFFUSION SOLUTION. Kendall, J. M. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Mar 1975. 61p. Dep. NTIS $5.45.

A solution of the differential equations for a one dimensional time dependent heat conduction problem is used to generate approximate transfer functions for the response for the geometry defined by the boundary conditions. The resulting approximate transfer functions are used to develop a method for calculating the transient surface conditions of simulated nuclear fuel rods from known transient internal conditions. The method is applied to example cases based on the results of selected experiments. The primary advantages of the method are computational speed and stability. The principal limitations are the assumptions of constant thermal properties (independent of temperature) to obtain a linear system, and uncertainties associated with the approximate forms of transfer functions. The approximation functions are not unique; the specific functions discussed were generated based on quasi-steady state considerations. For the parameters studied, the approximation for the measured temperature/surface heat flux transfer function is the most limiting. Further refinements of the approximations could be expected to reduce this source of error. (auth)

2680 (GEAP-20731) TOPICAL REPORT: DETERMINATION OF TRANSIENT HEAT TRANSFER COEFFICIENTS AND THE RESULTANT SURFACE HEAT FLUX FROM INTERNAL TEMPERATURE MEASUREMENTS. Muzzy, R. J.; Avila, J. H.; Root, D. E. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jan 1975. Contract AT(04-3)-189. 119p. Dep. NTIS $5.45.

The determination of transient heat transfer coefficients and/or the surface heat flux from internal temperature measurements has received considerable attention as a measurement technique in situations where surface measurements cannot be made. The general data analysis method depends on solving the inverse heat conduction problem. In general, exact solutions are not practical for the type of problem considered in this application, but a numerical approach has been developed which is shown to be a good method for the analysis of blowdown heat transfer (BDHT) data. This technique has been developed for an application involving a transition from nucleate to film boiling heat transfer. It utilizes an explicit finite difference procedure that handles the nonlinear problem involving temperature-dependent properties and complex multi-layer geometry. The technique minimizes, at time t, the sum of the squares of the differences between the calculated and the measured thermocouple temperatures over a finite number of time steps greater than t. A computer code, called HCODE, based on this technique was developed for analysis of experimental data to obtain transient surface temperature, heat flux, and heat transfer coefficients using internal temperature measurements. The ability of HCODE to track rapid changes in surface temperature and heat transfer coefficients is demonstrated by comparison with exact solutions. It is shown that the technique developed herein represents an improvement over existing techniques. HCODE is then applied to data from the Blowdown Heat Transfer (BDHT) program in which direct type electrically heated rods experience a transition from nucleate to film boiling during a simulated loss-of-coolant accident (LOCA). Correct heater rod modeling and material properties are verified by comparison with data from stagnant steam heatup tests in which the surface heat transfer coefficients are well known. Typical thermocouple data representative of LOCA type transients are then examined with HCODE. 24 references. (auth)

2681 (IRS-A-6) ASEISMIC DESIGN OF OPERATIONAL COMPONENTS AND PIPINGS. General Report. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Sep 1974. 165p. (In German). INIS.

With figs., tabs, and refs. Translated from Technical Guidelines for Aseismic Design of Nuclear Power Plants, JEAG-4601-1970, chapter 5.

This report is a translation of chapter 5 of "Technical Guidelines for Aseismic Design of Nuclear Power Plants" of the Japan Electric Association, published in 1970 (JEAG-4601-1970). (GE)

2682 (KFK-2047) PROBLEM OF PIN TO PIN FAILURE PROPAGATION IN LIQUID METAL FAST BREEDER REACTORS. Jacobi, S.; Kramer, W.; Schleisiek, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Feb 1975. 31p. (In German). Dep. NTIS (US Sales Only) $4.75.

The possibility of a pin to pin failure propagation is an important question in connection with the safety analysis of LMFBR. A brief review of the present state of knowledge is presented. Conceivable mechanisms of an accident sequence are discussed and the possibilities for a fast failure propagation are demonstrated. As a result of the present investigations to this question a pin to pin failure propagation is considered to be rather unlikely but it may not be excluded completely under certain accident conditions. 55 references. (auth)

2683 (KFK-2050, pp 270-277) RISK AND RELIABILITY ANALYSIS OF NUCLEAR PLANTS. A State of the Art Study on Methods for the Quantitative Analysis and Evaluation of the Risks in the Nuclear Fuel Cycle. Papp, R.; Caldarola, L.; Helm, F.; Jansen, P.; McGrath, P.; Weber, G.; Wittek, G. Aug 1974. (In German).

With refs.

In 1st semi-annual report 1974.

A brief outline is given of the completed state-of-the-art study, "Methods for the quantitative analysis and evaluation of risks for nuclear facilities." Within the framework of this study, cost-benefit analyses have not been considered but the present state and evidence of the existing methods and procedures have been investigated and evaluated. (GE)

2684 (KFK-EXT-28/74-2, pp vp) PROBLEM OF THE BEHAVIOUR OF FUEL RODS IN LIGHT WATER REACTORS IN LOSS OF COOLANT ACCIDENTS. Fischer, M. Nov 1974. (In German).

From annual colloquium of the Projekt Nukleare Sicherheit; Karlsruhe, F.R. Germany (19 Nov 1974).

15 figs.

In annual colloquium 1974 of the Projektt Nukleare Sicherheit.

The state of knowledge in the field of fuel rod behavior in loss of coolant accidents in light water reactors is reviewed. (GE)

2685 (KFK-EXT-28/74-2, pp vp) ON THE MATERIAL BEHAVIOUR OF ZIRCALOY CLADDING TUBES IN A LOSS OF COOLANT ACCIDENT. Bocek, M.; Leistikow, S.; Hofmann, P. Nov 1974. (In German).

From annual colloquium of the Projekt Nukleare Sicherheit; Karlsruhe, F.R. Germany (19 Nov 1974).

15 figs.

In annual colloquium 1974 of the Projekt Nukleare Sicherheit.

It is necessary to know the exact manner of deformation of the fuel rod cladding tube for the design of emergency cooling systems. Above all, the change of diameter of the tube as a function of time during the loss-of-coolant accident (LOCA) must be known. Furthermore, data on the expansion and yield limit values are necessary, which if exceeded will result in the tube bursting open. In order to be able to solve this problem, all factors must be known which could effect the plastic behavior of Zircaloy in the temperature interval of the LOCA. (GE)

2686 (MRR-139) PROBLEMS OCCURRING IN THE ANALOG MEASUREMENT OF FAST TRANSIENTS. Maier, H. D. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jun 1974. 76p. (In German). INIS.

15 figs.; 64 refs.

The most important measurement devices currently used in reactor safety monitoring are discussed in a system-theoretical view. Sufficiently exact substitutional transfer functions for all measurement components are given. By this means it is possible to estimate the expected dynamical behavior of a measurement component. Methods are discussed of correcting or diminishing (on-line or off-line) the dynamic error created by the dynamic behavior of the measurement chain. (auth)

2687 (ORNL-TM-4774) GUIDE TO GENERAL ATOMIC STUDIES OF HYPOTHETICAL NUCLEAR DRIVEN ACCIDENTS FOR THE FORT ST. VRAIN REACTOR. Wei, T.; Tobias, M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 47p. Dep. NTIS $5.45.

The work of the General Atomic Company (GAC) in preparing those portions of the Final Safety Analysis Report for the Fort St. Vrain Reactor (FSV) having to do with hypothetical nuclear driven accidents has been reviewed and a guide to this literature has been prepared. The sources for this study are the Final Safety Analysis Report itself, the Quarterly and Monthly Progress Reports, Topical Reports, and Technical Specifications. The problems considered and the methods used are outlined. An appendix gives a systematic analysis which was used as a guide in organizing the references. (auth)

2688 (ORNL-TM-4888) MONTHLY HIGHLIGHTS FOR REACTOR SAFETY DIVISION PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 41p. Dep. NTIS $5.25.

Summaries of reactor safety research program activities during February 1975 are presented. (DCC)

2689 (RSA-TM-1) PRELIMINARY REPORT ON LOSS-OF-FLOW CALCULATIONS FOR THE CRBR DEMONSTRATION PLANT. Hummel, H. H.; Pizzica, P. (Argonne National Lab., Ill. (USA)). 26 Nov 1974. Contract W-31-109-Eng-38. 41p. Dep. NTIS $5.25.

Loss-of-flow calculations have been performed for the Clinch River Breeder Reactor. Results are preliminary because of inaccuracy in the reactor model, but are not expected to be much different when model corrections are made. A pump coastdown calculation without scram, and very rapid flow decay calculations with and without scram to simulate pipe rupture accidents have been carried out. For a wide range of flow decay rates without scram a mild initial disassembly caused by a few atmospheres fuel vapor pressure occurs. It appears that boiling can be prevented in a double-ended pipe rupture with scram if core flows of about 25 percent or more of the initial can be maintained after the rupture, with the required final flow rate sensitive to fuel-clad gap conductance. (auth)

2690 (SRD-R-38) CALCULATION OF THE PROBABILITY OF FUEL PIN SWELLING IN A BWR DURING A LOSS-OF-COOLANT ACCIDENT. Brock, P. (UKAEA Safety and Reliability Directorate, Culcheth). 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

It has been demonstrated that a method of calculating fuel pin swelling in a LOCA, which is used in the routine safety assessment of Winfrith SGHWR, could equally well be applied to a BWR. A specimen calculation using notional data has been carried out. (auth)

2691 (STH-9/74) DETERMINATION OF SINGLE NUCLIDES IN AEROSOL- AND IODINE FILTER SAMPLES FROM THE EXHAUST AIR OF THE NUCLEAR POWER PLANTS GUNDREMMINGEN, OBRIGHEIM, WUERGASSEN AND STADE. Winkelmann, I. (Bundesgesundheitsamt, Berlin (F.R. Germany). Abt. fuer Strahlenhygiene). Aug 1974. 16p. (In German). INIS.

24 figs.; 17 tabs.; 7 refs.

Since the beginning of 1972, aerosol and iodine samples from the exhaust air control plants on the chimneys of the nuclear power plants Gundremmingen, Obrigheim and Stade have been examined with gamma spectrometric methods on single nuclides by the Federal Ministry of Health. In 1973, the investigations were also extended to the nuclear power plant Wuergassen. The extension of this filter measuring program to the nuclear power plants Lingen and Biblis is planned for the end of 1974. The aim of the investigations is to determine from the measured activities of single nuclides given off with the exhaust air, the contribution of this nuclide group to the irradiation load of the population in the environment of the nuclear power plants considered here and to obtain experience for the preparation of uniform measuring specifications for controlling radioactive emissions at nuclear power plants. (GE)

2692 (WANL-TME-1061(Part 1)) SAFETY EVALUATION REPORT. Part I. Review of Nuclear Safeguards for NRX Reactors During Pre-Test Assembly Operation at NRDS. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Dec 1964. 21p. Dep. NTIS $4.25.

The safeguards which will prevent accidental criticality during operations with NRX reactors prior to initial criticality are summarized. These operations include receipt of the reactor at NRDS, inspection, assembly of the test assembly, transport to TCA, and checkout at TCA prior to initial criticality. It is intended that the present review permit alteration of the sequence of these operations without further consideration if the basic safeguards discussed below are in effect. In so far as actual operation of the reactor during these phases is not intended, the applicable safeguards are the mechanical, procedural and administrative controls which insure that accidental criticality does not occur. The potential mechanisms which could lead to an accidental criticality of an NRX reactor in the NRDS assembly area or at TCA prior to initial criticality are identified and discussed: accidental insertion of moderation, particularly hydrogenous material, after the shipping poison wire system is removed; loss of shutdown margin through excess reflection; accidental rotation of control drums during periods when auxiliary poison is not used; and loss of shutdown margin during removal of the auxiliary poison. The safeguards against these potential problems are outlined. (auth)

2693 (WANL-TME-1061(Rev. 1)) SAFETY EVALUATION REPORT. Phase I. Review of Nuclear Safeguards for NRS Reactors During Pre-Test Assembly Operation at NRDS. Draft. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1967. 30p. Dep. NTIS $4.50.

The purpose of Phase 1 of the Safety Evaluation Report is to summarize the safeguards which will prevent accidental criticality during operations with NRX reactors prior to initial criticality. These operations include receipt of the reactor at NRDS, inspection, assembly of the test article, transport to Test Cell "C," and checkout at Test Cell "C" prior to initial criticality. (auth)

2694 (WANL-TME-1413(Suppl.1)) NRX-A5 SAFETY EVALUATION REPORT. Supplement 1. Meyer, L. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 May 1966. 7p. Dep. NTIS $4.00.

The safety implication of using the Integral Nuclear Instrumentation System (INIS) for nuclear power control of the NRX-A5 is reviewed. The INIS consists of neutron detectors, developed for NERVA Engine application, and an eight decade log power control system. The INIS neutron detectors will be mounted on the test car but the NRX/EST detectors will be retained in the water tank for use if required. A detailed description of the INIS, and the

experience gained with the INIS detectors during the NRX/EST test, have been reported. It is concluded that use of the INIS does not introduce any new safety problems in the operation of NRX-A5. As additional safety protection, a power level scram using the two TCA linear power channels will be added for full power operation. (auth)

2695 (WANL-TME-1413(Suppl.2)) NRX-A5 SAFETY EVALUATION REPORT. Supplement 2. Skaritka, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 May 1966. 21p. Dep. NTIS $4.25.

Certain changes and revisions in the report on NRX-A5 safety are presented. Most of these resulted from changes in the test system or from requests for additional supporting information or requests for clarification. The planned power tests are described in detail. Effects of possible malfunctions have been reexamined using the Common Analog model. Sufficient protection has usually been provided, but a few malfunctions are still under investigation. (LTN)

2696 (WANL-TME-1413(Suppl.2)(Add.1)) NRX-A5 SAFETY EVALUATION REPORT. Supplement 2, Addendum 1. Skaritka, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Jun 1966. 6p. Dep. NTIS $4.00.

The consequences of accidental full opening of PCV-41 during NRX-A5 operation were presented in the NRX-A5 SER for operating conditions above 50% power. Revision to the analytical model has permitted additional analysis to be performed which shows that inadvertent full opening of PCV-41 with high tank farm pressures during operation on LH_2 at chamber temperatures below about 3000°R leads to a reactivity pulse and a pressure wave momentarily exceeding the test limit for the graphite inner reflector. It is recognized that single malfunctions in the valve servo or electrical controls can lead to this occurrence. Leaving the period scram active during the interval in which this risk exists reduces the integrated energy caused by the reactivity pulse to a negligible value, although in no case does the energy without a period scram lead to either system damage of fission product release. Although no question of nuclear safety is involved, the possibility of an excursion affecting reactor condition is precluded by the addition of a test limit requiring the activation of a period scram below the power level at which this excursion energy leads to an appreciable temperature increment. (auth)

2697 (WANL-TNR-096) NRX-A HAZARDS REPORT SITE DESCRIPTION. Calley, H. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Apr 1963. 41p. Dep. NTIS $5.25.

Full scale static testing of NERVA reactors will be conducted at the Nevada Test Site (NTS) where radiological safety, security, and access control regulations are already well established and where test cells and support facilities already exist. Special site requirements for testing nuclear rocket propulsion systems are established in Report No. LA-2409, "Nuclear Safety Aspects of the Rover Program," dated March 1, 1960. Operational experience with both nuclear weapons testing and the KIWI and TORY series of reactor tests at NTS indicates the adequacy of this site in fulfilling these requirements and minimizing radiological hazards to operating personnel and the general population. The topography, geology, meteorology and population density of the surrounding area are given. (auth)

2698 NUCLEAR POWER, SAFETY AND ENVIRONMENT PROTECTION. Eklund, S. (International Atomic Energy Agency, Vienna (Austria)). Arch. Energiewirt., 28: No. 23, 1173-1183 (Dec 1974). (In German).

In a talk in front of industrialists in Stockholm which is reproduced here in excerpts, the general secretary of the International Atomic Agency, S. Eklund, was of the opinion that as long as no new energy sources are discovered, nuclear energy offers the means, despite all risks, to still the world's energy hunger. (GE)

2699 THE BALANCING TREATMENT OF DECONTAMINATION COSTS OF NUCLEAR POWER PLANTS. Maul, K. H. (Frankfurt Univ. (F. R. Germany). Juristische Fakultaet). Atomwirt., Atomtech.; 20: No. 1, 43-46(Jan 1975). (In German).

The estimation of possible decontamination costs for a nuclear power plant is extremely problematic because there are no empirical values for numerous cost-dependent factors due to the fact that a suitable form of decontamination has not yet been found. It is certain that the decontamination of nuclear power plants is a public and legal obligation, which has to be fulfilled by the operator from the first day of criticality. The operator has to prepare a reserve for the existing but undefined obligation of payment. The estimation of this reserve and the annual cost valuation are thoroughly examined. The probable decontamination costs of a nuclear power plant have to be considered as expenditures in the form of 15 equal annual rates from the time of first criticality. (auth)

2700 ENVIRONMENTAL AND LICENSING ASPECTS OF HIGH TEMPERATURE REACTORS. Mueller, H. W. BBC-Nachr.; 56: No. 11, 483(1974). (In German).

Nuclear power plants with high-temperature reactors meet the requirement of keeping the thermal and radioactive pollution of the environment as low as possible. A special developmental potential in this regard is offered by the operation of a high-temperature reactor in a closed gas turbine loop. (GE

2701 SOME CRUCIAL ISSUES IN NUCLEAR ENERGY. Weinberg, A. M. (Federal Energy Administration, Washington, DC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 31-34(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Technical and non-technical issues concerning the development of nuclear energy as a substantial and valid energy source in the U.S. are discussed. 9 references. (DCC)

2702 GENERAL ELECTRIC BWR/6 STANDARD PLANT. Stuart, I. F.; Johnson, R. B.; Geurts, J. R. Trans. Amer. Nucl. Soc.; 20: 10-11(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975)

2703 REACTOR PROTECTION SYSTEM FOR KWU LIGHT-WATER REACTORS. Bachmann, G.; von Haebler, D. Trans. Amer. Nucl. Soc.; 20: 39-40(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2704 INFLUENCE OF SAFETY CRITERIA ON DESIGN OF INSTRUMENTATION SYSTEMS IN PWR PLANTS. Authier, J. C. Trans. Amer. Nucl. Soc.; 20: 40-42(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2705 CAORSO SEISMIC DESIGN OF SAFETY-RELATED ELECTRICAL AND I AND C EQUIPMENT. Annino, E.; Batocci, L.; Ceriati, F. Trans. Amer. Nucl. Soc.; 20: 44-46(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2706 SOME ASPECTS OF NUCLEAR REACTOR MATERIALS BEHAVIOR UNDER ACCIDENT LOADINGS. Kirillov, A. P. Trans. Amer. Nucl. Soc.; 20: 64-66(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2707 INVESTIGATION OF DYNAMIC FEEDBACK EFFECTS ON THE SEISMIC DESIGN OF NUCLEAR POWER PLANTS. Mukherjee, S. Trans. Amer. Nucl. Soc.; 20: 69-71(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2708 RECENT METHODS OF STRUCTURAL ANALYSIS FOR NUCLEAR REACTORS CEA-SEMT COMPUTER CODES. Goldstein, S.; Hoffmann, A.; Jeanpierre, F.; Livolant, M.; Roche, R. Trans. Amer. Nucl. Soc.; 20: 71-73(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2709 APPLICATION OF FRACTURE MECHANICS TO PWR VESSELS. Pellissier-Tanon, A.; Vagner, J.; Devaux, J. C. Trans. Amer. Nucl. Soc.; 20: 73-75(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2710 SIMULATION OF AN INTERNAL CONTAINMENT SPRAY COOLING SYSTEM FOR LIGHT-WATER-COOLED POWER REACTORS. Brosche, D. Trans. Amer. Soc.; 20: 75-79(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2711 HEALTH PHYSICS DURING THE FIRST GENERAL INSPECTION OF ARDENNES NUCLEAR POWER PLANT. Martin, J. J.; Reihl, R. Trans. Amer. Nucl. Soc.; 20: 151-152(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2712 EXPERIENCE GAINED AT THE PHENIX REACTOR WITH REGARD TO PROTECTION ASPECTS. Goddet, J.; Peyresblanques, H.; Galissian, F.; Meffre, P. Trans. Amer. Nucl. Soc.; 20: 166-168(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2713 RECENT UK RESEARCH INTO WATER REACTOR LOCA FUEL BEHAVIOR. Duffey, R. B.; Healey, R.; Piggott, B. D. G. Trans. Amer. Nucl. Soc.; 20: 220-222(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2714 EVALUATION OF THE CLADDING PEAK TEMPERATURE AND PERCENT EQUIVALENT METAL-CLADDING-REACTED CRITERIA FOR LWR. Perez, R.; Wazzan, A. R. Trans. Amer. Nucl. Soc.; 20: 226-229(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2715 SPACE-TIME-DEPENDENT CODES AND PROBLEMS OF FEW-GROUP CROSS-SECTION SCHEMES. Vaeth, L.; Struwe, D. Trans. Amer. Nucl. Soc.; 20: 254-256(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2716 INFLUENCE OF OPERATING PROBLEMS ON NUCLEAR PLANTS DESIGN. Lhuillery, A. Trans. Amer. Nucl. Soc.; 20: 424-426(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2717 BASIC CONSIDERATIONS OF SAFETY PRINCIPLES FOR THE BASF NUCLEAR POWER PLANT. Birkhofer, A.; Smidt, D. Trans. Amer. Nucl. Soc.; 20: 441-442(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2718 ENGINEERED SAFEGUARDS FOR THE NUCLEAR MERCHANT SHIP NCS-80. Koehler, W. H.; Seeliger, D. Trans. Amer. Nucl. Soc.; 20: 444-445(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2719 RECENT SAFETY-RELATED DEVELOPMENTS IN PRESSURIZED WATER REACTORS. Stathoplos, A. Trans. Amer. Nucl. Soc.; 20: 445-448(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2720 SGHWR LOSS-OF-COOLANT ACCIDENTS. Smith, D. R.; Bradley, N.; Hicks, D.; Cowan, A. Trans. Amer. Nucl. Soc.; 20: 448-449(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2721 LIGHT-WATER REACTORS: SAFETY PROBLEMS AND RELATED STUDIES IN FRANCE. Lelievre, J. Trans. Amer. Nucl. Soc.; 20: 449-451(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2722 METHODS AND TECHNIQUES OF THE EVALUATION OF THE SECURITY PROBABILITY OF NUCLEAR REACTORS. Procaccia, M.; Philippe, J. M. Trans. Amer. Nucl. Soc.; 20: 458(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2723 PWR ELECTRICAL SUPPLY OPERATING RULES DETERMINED BY PROBABILISTIC APPROACH. Blin, A.; Boursier, M.; Carnino, A.; Greppo, J. F. Trans. Amer. Nucl. Soc.; 20: 458-459(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2724 PAT-REC-DE CODE: EVALUATION OF COMMON MODE FAILURES IMPACT ON RELIABILITY. Blin, A.; Carnino, A.; Jubault, G.; Mollard, C. Trans. Amer. Nucl. Soc.; 20: 459-461(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2725 NECESSITY AND FEASIBILITY OF SPACE-TIME DEPENDENT LWR CALCULATIONS. Frisch, W.; Langenbuch, S.; Maurer, W.; Werner, W. Trans. Amer. Nucl. Soc.; 20: 461-463(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2726 CREYS-MALVILLE PLANT: SAFETY PROBLEMS CONCERNING DESIGN AND CONSTRUCTION. Le Marechal, T.; Lucenet, G.; Meyer-Heine, A.; Chalot, A.; Malaval, C. Trans. Amer. Nucl. Soc.; 20: 464(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2727 SAFETY CRITERIA FOR THE SUPER-PHENIX REACTOR. Justin, F.; Argous, J. P.; Giudicelli, A. Trans. Amer. Nucl. Soc.; 20: 464-466(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2728 DESIGN MARGIN APPROACH IN LMFBR SAFETY. Graham, J.; Strawbridge, L. E. Trans. Amer. Nucl. Soc.; 20: 466-468(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2729 DESIGN AND SAFETY CONSIDERATIONS FOR A 1000-MW(e) GAS-COOLED FAST REACTOR. Donne, M. D.; Goetzmann, C. A. Trans. Amer. Nucl. Soc.; 20: 468-471(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2730 SAFETY CHARACTERISTICS OF GAS-COOLED BREEDERS WITH PIN FUEL. Vieider, G.; Burgsmueller, P.; Dekais, J. J.; Delogu, B.; Kraehe, A.; Pignatelli, R.; Oppenheim, C. Trans. Amer. Nucl. Soc.; 20: 471-473(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2731 CONTRIBUTIONS TO THE SAFETY ANALYSIS OF PEBBLE-BED HTRs. Scharf, J.; Vigassy, J. Trans. Amer. Nucl. Soc.; 20: 473-476(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2732 INHERENT SAFETY CHARACTERISTICS AND SAFEGUARDS SYSTEMS FOR THE GA/HRB HTGR. Paul, D. J.; Eisele, H. Trans. Amer. Nucl. Soc.; 20: 476-478(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2733 HIGH-TEMPERATURE REACTOR SAFETY AND ENVIRONMENT. Brisbois, J.; Chapelot, A.; Charles, J. Trans. Amer. Nucl. Soc.; 20: 478-480(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2734 STUDIES ON CRITICALITY SAFETY PROBLEMS BY WATER IN SYSTEMS WITH HTR FUEL. Drueke, V.; Filges, D.; Kirch, N.; Neef, R. D. Trans. Amer. Nucl. Soc.; 20: 480-482(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2735 CALCULATIONS COMPARED WITH EXPERIMENTS SIMULATING DIFFERENT BLOWDOWNS. Friz, G.; Riebold, W.; Lange, D.; Megnin, J. C. Trans. Amer. Nucl. Soc.; 20: 483-484(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2736 BLOWDOWN PROJECT AND PREVIOUS STUDIES AT ISPRA CONNECTED WITH LWR-LOCA. Grass, G.; Friz, G.; Riebold, W. Trans. Amer. Nucl. Soc.; 20: 484-486(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2737 CRITICAL HEAT FLUX DURING BLOWDOWN WITH REVERSED FLOW. Leung, J.; Jones, O. C.; Henry, R. E.; Bankoff, S. G. Trans. Amer. Nucl. Soc.; 20: 486-488(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2738 EXPERIMENTAL MEASUREMENTS OF LARGE PIPE TRANSIENT BLOWDOWN. Hutchson, M. N.; Henry, R. E.; Wollersheim, D. E. Trans. Amer. Nucl. Soc.; 20: 488-490 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2739 ECCS CRITERIA CONSEQUENCES FOR THE FRAMATOME NUCLEAR POWER PLANTS. Oullion, J. Trans. Amer. Nucl. Soc.; 20: 490-491(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2740 STUDY OF THE UNSTEADY REFLOODING OF WATER REACTOR CORES. White, E. P.; Duffey, R. B. Trans. Amer. Nucl. Soc.; 20: 491-494(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2741 DSF-P1: AN EMERGENCY CORE COOLING EXPERIMENT FOR BWRs. Eriksson, S. O. Trans. Amer. Nucl. Soc.; 20: 494-496(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2742 ECC AND STEAM INTERACTION IN THE COLD LEG PIPING. Lowe, P. A. Trans. Amer. Nucl. Soc.; 20: 497-501 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2743 EXPERIMENTS AND ANALYSIS IN EMERGENCY CORE COOLING. Courtaud, M.; Karwat, H.; Mayinger, F. Trans. Amer. Nucl. Soc.; 20: 501-503(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2744 INVESTIGATION OF THE RESONANCE PHENOMENA IN THE PS CONTAINMENT OF THE MARVIKEN REACTOR DURING BLOWDOWN. Appelt, K. D.; Kadlec, J.; Wolf, E. Trans. Amer. Nucl. Soc.; 20: 503-508(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2745 SERIES OF CONTAINMENT RESPONSE EXPERIMENTS IN THE MARVIKEN POWER PLANT. Ericson, L. Trans. Amer. Nucl. Soc.; 20: 508-510(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2746 THERMAL FUEL ROD TRANSIENTS DURING POSTULATED REACTOR ACCIDENTS. Nijsing, R.; Eifler, W. Trans. Amer. Nucl. Soc.; 20: 511-513(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2747 FISSION PRODUCT RELEASE FROM A PWR CORE UNDER LOCA CONDITIONS. Mattila, L. Trans. Amer. Nucl. Soc.; 20: 513-515(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2748 FISSION PRODUCT RELEAST FROM LWR CONTAINMENTS UNDER LOCA CONDITIONS. Aro, I.; Mattila, L. Trans. Amer. Nucl. Soc.; 20: 515-517(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2749 RADIOLOGICAL CONSEQUENCES OF LEAKAGE IN EXTERNAL RECIRCULATION LOOP FOLLOWING LOCA. Fray, R. R.; Freund, G. A. Trans. Amer. Nucl. Soc.; 20: 517-518 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2750 SAS3A SODIUM BOILING MODEL AND ITS EXPERIMENTAL BASIS. Hoeppner, G.; Dunn, F. E.; Heames, T. J. Trans. Amer. Nucl. Soc.; 20: 519-521(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2751 INCIPIENT BOILING OF LIQUID METALS IN FLOWING SYSTEMS. Winterton, R. H. S. Trans. Amer. Nucl. Soc.; 20: 521-522(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2752 SUPERHEAT TO BE EXPECTED IN FAST REACTOR BOILING INCIDENTS. Holland, P. K.; Winterton, R. H. S. Trans. Amer. Nucl. Soc.; 20: 523-524(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2753 FUEL PIN MODELING RELATED TO LMFBR SAFETY ANALYSIS. Kuczera, B.; Elbel, H. Trans. Amer. Nucl. Soc.; 20: 525-527(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2754 IN-PILE SAFETY TESTS ON FAST REACTOR FUELS. Bailly, J.; Kessler, G.; Teague, H. J. Trans. Amer. Nucl. Soc.; 20: 527-528(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2755 LOCAL FAULTS IN FAST REACTOR FUEL SUBASSEMBLY. An, S. (Tokyo Univ.); Kondo, S.; Tezuka, M.; Sawada, T.; Ohtsubo, A.; Kikuchi, Y.; Kawaguchi, O. Trans. Amer. Nucl. Soc.; 20: 529-531(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2756 FAST REACTOR SUBASSEMBLY FAULTS: A PERSPECTIVE. Cobb, E. C.; Gilby, E. V.; Wolff, P. H. W. Trans. Amer. Nucl. Soc.; 20: 531-532(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2757 THERMAL INTERACTIONS IN LMFBRs. Fauske, H. K. Trans. Amer. Nucl. Soc.; 20: 532-534(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2758 RECENT RESULTS FROM TREAT TESTS ON FUEL, CLADDING, AND COOLANT MOTION. Dickerman, C. E.; Barts, E. W.; De Volpi, A.; Holtz, R. E.; Neimark, L. A.; Rothman, A. B. Trans. Amer. Nucl. Soc.; 20: 534-535(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2759 LARGE-SCALE VAPOR EXPLOSIONS IN A CONSTRAINED SYSTEM. Henry, R. E.; McUmber, L. M.; Parker, N. E. Trans. Amer. Nucl. Soc.; 20: 535-539(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2760 MECHANICAL RESPONSE OF LMFBR CORES UNDER TRANSIENT PRESSURE LOADING. Liebe, R.; Will, H.; Zehlein, H. Trans. Amer. Nucl. Soc.; 20: 539-543(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2761 LOCAL FAILURE PROPAGATION IN LMFBRs. Jacobi, S.; Kramer, W.; Krieg, R.; Schleisiek, K. Trans. Amer. Nucl. Soc.; 20: 543-545(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2762 THERMAL-HYDRAULIC CORE DEBRIS BEHAVIOR IN THE SNR-300 REACTOR VESSEL AFTER HCDAs. Struwe, D.; Groetzbach, G.; Meyder, R. Trans. Amer. Nucl. Soc.; 20: 545-546(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2763 STUDIES OF CORE DISRUPTIVE ACCIDENTS AND LICENSING ASPECTS OF FAST BREEDER REACTORS. Speis, T. P.; Allen, C. L.; Alcouffe, R. E.; Denise, R. P.; Kastenberg, W. E.; Theofanous, T. G. Trans. Amer. Nucl. Soc.; 20: 547-548(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2764 POST-ACCIDENT HEAT REMOVAL. Catton, I.; Kastenberg, W. E.; Okrent, D. Trans. Amer. Nucl. Soc.; 20: 548-551(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2765 ISPRA'S CONTRIBUTION TO THE ANALYSIS OF CONSEQUENCES OF HYPOTHETICAL EXPLOSIVE ACCIDENTS IN FAST REACTORS. Albertini, C.; Benuzzi, A.; Donea, J.; Fasoli-Stella, P.; Finzi, S.; Holtbecker, H.; Kottowski, H.; Montagnani, M.; Verzelletti, G. Trans. Amer. Nucl. Soc.; 20: 551-554(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2766 INCIDENT DETECTION SYSTEM AND CORE SURVEILLANCE FOR FAST REACTORS. de Lapparent, D.; Gourdon, J.; Gouriou, A.; Jallade, M.; Leguillou, G.; Pages, J. P.; Paziaud, A. Trans. Amer. Nucl. Soc.; 20: 556-557(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2767 EXPERIMENTAL STUDIES ON SODIUM FIRES. Application to Reactors. Fruchard, Y.; Cercy, J.; Colome, J.; Duco, J.; Malet, J. C. Trans. Amer. Nucl. Soc.; 20: 558-559 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2768 QUALITY ASSURANCE FOR HEAVY REACTOR COMPONENTS IN AUSTRIA. de Comtes; Wallner; Zwingenberger. Trans. Amer. Nucl. Soc.; 20: 563-565(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2769 QUALITY ASPECTS OF LIGHT-WATER REACTOR PRESSURE BOUNDARY COMPONENTS. Kussmaul, K. (Univ. of Stuttgart); Trumpfheller, R. Trans. Amer. Nucl. Soc.; 20: 565-567(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2770 THOUGHTS ABOUT QUALITY ASSURANCE DURING ELECTRICITE DE FRANCE NUCLEAR PLANT OPERATIONS. Feger, M. Trans. Amer. Nucl. Soc.; 20: 578-581(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2771 QUALITY ASSURANCE IN ITALY: RECENT EXPERIENCE AND FUTURE TRENDS. Zambrini, R.; Tenaglia, G. Trans. Amer. Nucl. Soc.; 20: 581-582(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2772 QUALITY ASSURANCE PROGRAM FOR EdF'S NUCLEAR POWER PROJECT. Milliat, J. P.; Vaujour, J. A. Trans. Amer. Nucl. Soc.; 20: 582-583(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2773 QUALITY MANAGEMENT IN AN INTERNATIONAL NUCLEAR POWER PLANT PROJECT. Brion, J.; Crustin, J. Trans. Amer. Nucl. Soc.; 20: 583-585(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2774 CAN QUALITY ASSURANCE BE SAFETY ORIENTED AND COST EFFECTIVE. Burgess, N. T. Trans. Amer. Nucl. Soc.; 20: 585-587(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2775 QUALITY ASSURANCE. French, F. J. Trans. Amer. Nucl. Soc.; 20: 587-588(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2776 NATURE AND FINALITY OF LIABILITY INSURANCE SUPPORT TO NUCLEAR OPERATORS. Deprimoz, J. Trans. Amer. Nucl. Soc.; 20: 808-809(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2777 MATERIAL DAMAGE INSURANCE OF NUCLEAR INSTALLATIONS. Miles, A. C. Trans. Amer. Nucl. Soc.; 20: 809-810(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2778 LIGHT-WATER REACTORS IN GERMANY. Braun, W.; Steinert, C. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Bereich Druckwasserreaktoren); Hundt, D. (Kraftwerk Union A. G., Offenbach (F. R. Germany). Bereich Siedewasserreaktoren). Elektrotech. Z.; 96A: No. 1, 24-29(1975). (In German).
The development of light-water reactors has reached a stage at which they can be constructed and operated, from the safety point of view, independently of the conditions at the site. Their state of technical development is comparable to that of conventional power stations. The infastructure which has been developed by the industry which supplies materials ensures that nuclear power stations can assume a leading role in energy supply in the German Federal Republic. (auth)

2779 SELECTED ENVIRONMENTAL CONSIDERATIONS AND THEIR MEASURING PARAMETERS FOR NUCLEAR POWER PLANT SITING. Norris, J. A. (Atomic Energy Commission, Washington, DC). Nucl. Technol.; 25: No. 4, 592-597(Apr 1975).
The site selection process for nuclear power stations encompasses a broad range of considerations. A categorization of these considerations consistent with the needs of the U. S. Atomic Energy Commission, as the regulatory agency, and of the utility company involves these major areas of concern. They are issues related to safety, environmental impact, and engineering/economics. The more important environmental considerations and their measuring parameters presented in this paper include biota, ecological systems and water quality, land use, aesthetics, water availability, and meteorology. (auth)

2780 ENVIRONMENTAL ASSESSMENT MATRIX AS A SITE-SELECTION TOOL: A CASE STUDY. Tamblyn, T. A.; Cederborg, E. A. (Bechtel Power Corp., San Francisco). Nucl. Technol.; 25: No. 4, 598-606(Apr 1975).
Since passage of the National Environmental Policy Act of 1969, power plant siting procedures have undergone extensive change. The "environmental assessment matrix" was developed for use as an active tool in an ongoing nuclear power plant siting study. Its use is not intended to eliminate engineering judgment and ingenuity from the plant siting process, but rather to document the procedures used and conclusions drawn. When used in an iterative manner during a site-selection study, the environmental assessment matrix provides valuable insight into a complex evaluation problem, documentation of the logic used, and a graphic display that can be used for presentation at open meetings. (auth)

2781 SITE ACCEPTABILITY AND POWER AVAILABILITY: NEEDED INSTITUTIONAL CHANGES. Haggard, J. E. (Houghton, Cluck, Choghlin, and Riley, Seattle, WA). Nucl. Technol.; 25: No. 4, 607-616(Apr 1975).
Timely assurance of power plant site availability is threatened by institutional inabilities to resolve often competing environmental/energy requirements. Institutional changes are needed. The issue of site approval should be separated from that of plant approval. A "one-stop" forum for site approval, modeled after Washington State's Thermal Power Plant Siting Act, is needed. The one-stop process utilizes one forum composed of officials drawn from all agencies involved in site related issues. A joint Federal/State Siting Council, with sole jurisdiction over site approval, is recommended. The State Council would have a determinative vote on all issues not otherwise preempted by federal legislation. 21 references. (auth)

2782 POPULATION DISTRIBUTION CONSIDERATIONS IN NUCLEAR POWER PLANT SITING. Kholer, J. E.; Kenneke, A. P.; Grimes, B. K. (Atomic Energy Commission, Washington, DC). Nucl. Technol.; 26: No. 4, 617-625(Apr 1975).
The population distribution surrounding a site proposed for a nuclear power plant is an important consideration in the site selection process, and is relevant to both siting and environmental aspects of nuclear power plant siting. In addition, the reactor site criteria specified in 10 CFR Part 100 requires that the surrounding population be given consideration in the siting and design of the facility. Developing methods of analyzing the population distribution characteristics of alternative sites (as discussed in the environmental report for construction of a nuclear power plant) is necessary to arrive at a conclusion regarding the desirability of a proposed site. (auth)

2783 SITING CONSIDERATIONS FOR RADIOACTIVITY IN REACTOR EFFLUENTS DURING NORMAL OPERATION. Graf, J. M.; Strom, P. O. (Atomic Energy Commission, Washington, DC). Nucl. Technol.; 25: No. 4, 626-629(Apr 1975).
In selecting a proper site for a nuclear power station, the consideration of radioactivity released in effluents can be handled in a straightforward manner using the U. S. Atomic Energy Commission's proposed Appendix I to 10 CFR 50, which gives numerical guidelines for design objectives for meeting the criterion "as low as practicable" for radioactive material in light-water-cooled nuclear power reactor effluents. By relating the release of radioactive material, the site meteorological conditions, and site boundary distance through appropriate dose models, the suitability of a given site can be determined. "Rules of thumb" for comparing anticipated releases to design objectives can be constructed for rapid assessment using the maximum permissible concentration values of 10 CFR 20 as dose factors. These rules of thumb tend to underpredict the allowed releases except in the case of radiocesium in liquids. For gaseous releases, these rules of thumb can be made up in convenient nomogram form for a quick assessment of allowed releases based on local site meteorological conditions. (auth)

2784 SAFETY EVALUATIONS OF THE HTGR AS RELATED TO 10 CFR 100 SITING REQUIREMENTS. Moffette, T. R. (General Atomic International, Tokyo). Nucl. Technol.; 25: No. 4, 630-634(Apr 1975).
The high temperature gas-cooled reactor has inherent safety characteristics that permit this class of reactor to comply with the siting requirements of 10 CFR 100 with unique ease, particularly regarding the exclusion area boundary. As a consequence, the size of the reactor site can be selected without regard to 10 CFR 100, and the possibility of locating closer to populated areas is eased. The inherent safety characteristics are the all-ceramic reactor core with pyrocarbon fuel cladding, which can withstand very high temperatures, and the large mass of the core-graphite, which has a great thermal criteria. As a consequence, a slow "time-dependent" release of fission products to the containment would occur in the event of a hypothetical TID-type accident. 9 references. (auth)

2785 HAZARDS TO NUCLEAR PLANTS FROM SURFACE TRAFFIC ACCIDENTS. Hornyik, K. (Oregon State Univ., Corvallis). Nucl. Technol.; 25: No. 4, 651-657(Apr 1975).
Analytic models have been developed for evaluating hazards to nuclear plants from hazardous-materials accidents in the vicinity of the plant. In particular, these models permit the evaluation of hazards from such accidents occurring on surface traffic routes near the plant. The analysis uses statistical information on accident rates, traffic frequency, and cargo-size distribution along with parameters describing properties of the hazardous cargo, plant design, and atmospheric conditions, to arrive at a conservative estimate of the annual probability of a catastrophic event. Two of the major effects associated with hazardous-materials accidents, explosion and release of toxic vapors, are treated by a common formalism which can be readily applied to any given case by means of a graphic procedure. As an example, for a typical case it is found that railroad shipments of chlorine in 55-ton tank cars constitute a greater hazard to a nearby nuclear plant than equally frequent rail shipments of explosives in amounts of 10 tons. 11 references. (auth)

2786 SITING ENVELOPE FOR STANDARDIZED PLANTS. Gilbert, W. D.; Quirk, J. F. (General Electric Co., San Jose, CA). Nucl. Technol.; 25: No. 4, 658-669(Apr 1975).

A number of independent studies are being made to define the range of values to be associated with specific site parameters in different regions of the United States. A number of these studies have been published, are established as Atomic Energy Commission Regulatory Guides, or are in the process of being developed as industry standards. Similarly, the methods of defining design acceptability are in the process of being established. 16 references. (auth)

2787 SITE SELECTION AND EVALUATION OF ALTERNATIVES BY UNITED STATES UTILITIES. Rossin, A. D. (Commonwealth Edison Co., Chicago); Nichols, B. L. Nucl. Technol.; 25: No. 4, 670-674(Apr 1975).

Each electric utility faces unique problems in selecting generating sites. Companies and their consultants have used many methods for site selection and evaluation, and new siting methodologies are continually being developed. To analyze current practice and hopefully to provide a better background for utilities and the U. S. Atomic Energy Commission in preparing environmental evaluations of alternative sites, a study was authorized under the Atomic Industrial Forum's Nuclear Environmental Studies Project. The study revealed that a number of logics are in use and that a generic framework could be presented to describe the site selection process. (auth)

2788 METHOD FOR INTEGRATING SOCIETAL AND TECHNICAL JUDGMENTS IN ENVIRONMENTAL DECISION MAKING. Burnham, J. B. (Battelle-Pacific Northwest Labs., Richland, WA); Nealey, S. M.; Maynard, W. S. Nucl. Technol.; 25: No. 4, 675-681(Apr 1975).

A methodology was developed for environmental decision making that combines societal and technical judgments. Eight factors that characterized the major economic and environmental impacts of nuclear power plant sitings were identified. These factors were used to construct "mini-environmental impact statements" for six siting alternatives. The impact statements formed the core of a survey questionnaire administered to three groups of respondents. Data analysis produced estimates of the relative importance of each factor. A procedure is described for using these estimates of importance as weighting factors to be applied to techno-economic scores. These latter scores would be generated by technical experts and would represent the actual or anticipated impact of a plant siting upon the eight factors. (auth)

2789 METHOD FOR THE QUANTIFICATION OF AESTHETIC VALUES FOR ENVIRONMENTAL DECISION MAKING. Jones, G. R. (Jones and Jones, Seattle); Jones, I.; Gray, B. A.; Parker, B.; Coe, J. C.; Burnham, J. B.; Geitner, N. M. Nucl. Technol.; 25: No. 4, 682-713(Apr 1975).

The methodology for quantitative evaluation of visual impact considers the appearance and visual quality of a landscape setting as viewed from a series of representative viewpoints "before" and "after" the introduction of a nuclear facility. Procedures to select representative viewpoints are based on facility visibility from the surrounding area, viewing distance, observer position, and impacted viewing populations. A duplicate photo or slide taken from each representative viewpoint is touched up to portray the viewscape condition with the facility. The visual quality of each condition is then evaluated by applying the scaled measurements of intactness, vividness, unity, and importance of the major viewscape components, and these scores combined into a formula yielding a visual quality rating from 1 to 100. Total visual impact of a proposed facility is the sum of visual impacts measured at each representative viewpoint, with the difference between before and after conditions expressed in terms of percent of change modified by population viewing contact. An expression of the relative scarcity or uniqueness of the potentially impacted landscapes serves to protect remote areas and unique natural and cultural features. 14 references. (auth)

2790 METHODOLOGY FOR EVALUATING COMMUNITY ACCEPTANCE OF POWER PLANTS. Sucov, E. W. (Westinghouse Research Labs., Pittsburgh); Liang, C. K. Nucl. Technol.; 25: No. 4, 714-721(Apr 1975).

A rating method first identifies and evaluates the influence of various proponents in a siting controversy and then combines these strength measures into an overall measure of the degree of acceptance of a proposed power plant by the community. 7 references. (auth)

2791 HALDEN PROJECT: A NATIONAL TECHNICAL RESOURCE. Lunde, J. E. (Inst. for Atomenergi, Halden, Norway). Ingenioer-nytt; 11: No. 11, 20-21; 38(21 Mar 1975). (In Norwegian).

Following a brief outline of the history of the OECD Halden Reactor Project its activities in the fields of fuel testing are discussed. The application of on-line digital control is also an important aspect of the project's programme and a computer-based operator communication system using color TV screens to replace conventional instrumentation and graphic panels has been developed. Since 1959 the HBWR has accumulated over 50,000 hours operation without any serious incidents. A number of failures of experimental fuel elements has occurred but these have not led to activity releases of significance or to serious operational problems. In all cases of component failures the technical protection systems have functioned as planned. Routine, periodic accident exercises ensure that the emergency plans are kept up to date. It has been proposed that the Halden Project should form an information centre for reactor safety research for the participating countries. The Halden Reactor Project thus forms a significant national technical resource for Norway. (NO)

2792 EXPERIENCE WITH CONSTRUCTION AND OPERATION OF NUCLEAR POWER PLANTS: ACCIDENT RISKS. Rydell, N. (Oskarshamnsverkes Kraftgrupp AB, Stockholm). Ingenioer-nytt; 11: No. 8, 4-7(28 Feb 1975). (In Norwegian).

From conference on nuclear power: should we have doubts; Oslo, Norway (11 Feb 1975).

An attempt is made to rebut criticism by opponents of nuclear power that nuclear power plants are uneconomic, unreliable and unsafe, by presenting experience, largely from the Swedish Oskarshamn-1 reactor, but also from US reactors. It is stated that constructional delays vis-a-vis the schedules were largely due to lack of knowledge of the time factors involved and introduction of stricter rules during construction, and these were avoided in the second reactor. While Oskarshamn-1 has had a series of faults, mainly in the turbines, none have resulted in further damage, or release of radioactivity. While the load factor has not been satisfactory (53% since 1972) it is not worse than many other first-of-a-type reactors. In general nuclear plant load factors are acceptable and only slightly poorer than those of coal and oil fired plants. One area of uncertainty has been the repairability of core structures. The replacement of the feed water distributor in the Oskarshamn-1 reactor vessel is briefly described, showing, in addition to 7 similar repairs in other reactors, that such repairs are quite feasible. The level of radioactive effluents has been 10^{-2}–10^{-3} less than the limiting values. The reporting and incidence of faults and failures is discussed briefly in conclusion and it is asserted that these help to show that the level of safety is satisfactory since none have led to any damage or radioactive release. (NO)

2793 THE US NUCLEAR CONTROVERSY IN SWITZERLAND. Ind. At. Spatiales; 18: No. 4, 41-57(Jul 1974). (In English and French).

The second Lucern Workshop, held from 5th to 8th May 1974, and sponsored by the Swiss Association for Atomic Energy and the Atomic Industrial Forum of the United States, was organized in view of re-examining the state of the US nuclear controversy. The various questions on which the controversy is not centered after the dramatic changes in the Middle East oil situation towards the end of 1973 were discussed. Emphasis was put on the problems of public understanding and public acceptance by some of the best-known names on the American scene from government, industry and the academic world all closely concerned with the production, evaluation and control of nuclear power as the energy source of the future. (FR)

2794 NUCLEAR REGULATORY COMMISSION ACTION REQUIRING SAFETY INSPECTIONS WHICH RESULTED IN SHUTDOWN OF CERTAIN NUCLEAR POWERPLANTS. Joint Hearing Before the Joint Committee on Atomic Energy, Congress of the United States, and the Committee on Government Operations of the United States Senate, Ninety-Fourth Congress, First Session, February 5, 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 232p. GPO $2.25.

2795 POSSIBLE MODIFICATION OR EXTENSION OF THE PRICE-ANDERSON INSURANCE AND INDEMNITY ACT. Part 2. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session, May 9, 10, 14, 15, and 16, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 389p. GPO $3.45.

Reactor Theory and Calculation

Refer also to abstract 2861.

2796 (BLG-498) REACTIVITY AND PROMPT NEUTRON DECAY CONSTANT MEASUREMENTS BY MEANS OF THE PULSED NEUTRON TECHNIQUE. Vandeplas, P. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Dec 1973. 72p. Dep. NTIS (US Sales Only) $6.75.

The aim of the present work, performed in the scope of the Belgian plutonium recycling program, is to develop a reliable and

practical measurement method for determining the reactivity and the prompt neutron decay constant. First, the various approximations involved in the methods using the pulsed neutron technique, more especially in Sjöstrand's method, must be analyzed. Next, methods must be found to eliminate the influence of these approximations during the measurement itself, rather than by sophisticated interpretations or calculated corrections. The third step consists in elaborating the experimental determination of the error margin related to the measured values. The main problem arising in the measurements is the elimination of both the space and energy harmonics induced by the outer source. It can be solved by the adequate location of the source and the detectors and the adequate choice of the detector type. The interest of measuring the reactivity is closely related to the improvement of calculation methods. Therefore the knowledge of the error margin of the measured values is necessary. 20 references. (auth)

2797 (GSF-K-13(Ed.4)) PHYSICAL AND TECHNICAL PRINCIPLES OF NUCLEAR REACTORS. Bendler, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenschutz). Jun 1974. 63p. (In German). INIS.

12 figs.; 8 tabs.

A review is presented on the physical principles of nuclear reactors; it provides a survey of the various types of research and power reactors and discusses possible hazards due to the operation of nuclear reactors. (GE)

2798 (KFK-2048) PROPERTIES OF SOLUTIONS AND EIGENFUNCTIONS OF MULTIGROUP DIFFUSION PROBLEMS. Stewart, H. B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

A variational formulation of the static multigroup diffusion equations for heterogeneous assemblies provides a rigorous mathematical foundation for the solution of the time eigenvalue and the time-dependent initial value problems. Theorems on existence, uniqueness, regularity, and positivity are stated, and a proof that the generalized eigenfunctions are complete in L^2 is indicated. 12 references. (auth)

2799 (WANL-TME-537) FISSION PRODUCT INVENTORY PROGRAM. Call, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 80p. Dep. NTIS $7.00.

The WANL Fission Product Inventory Program (FPIP) is written in FORTRAN for the IBM-7094 computer. FPIP calculates the time behavior of the U-235 fission product activity resulting from a specified reactor operating history. The operating history can consist of as many as five separate operating periods, each at an arbitrary power level. The activity is calculated for each nuclide and summed for the total inventory. In addition, the program calculates the gamma and beta radiation energy source strengths in each of four gamma and five beta energy groups. The source strengths are given per nuclide per energy group, total per nuclide, total per energy group, and total for each time requested. (auth)

For abstracts of individual chapters see: 440, 610, and 611.

2800 (WANL-TMI-003) TEST OF THE MUFT-SOFOCATE-WANDA CALCULATION METHOD. McCutchan, D. A.; Bevard, D. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Aug 1960. 3p. Dep. NTIS $4.00.

In order to verify the accuracy of the MUFT-SOFOCATE-WANDA Calculation Scheme for intermediate spectrum reactors, calculations were made for a series of enriched-uranium, graphite-moderated critical experiments performed at Los Alamos and at Livermore. The accompanying table compares the theoretical results with the published experimental values. (auth)

2801 (WANL-TMI-567) NON-SEPARABLE KINETICS PROGRAM. Riese, J. W.; Laush, D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1963. 12p. Dep. NTIS $4.00.

2802 (WANL-TMI-616) DESCRIPTION OF TNS AND MUFT TAPES. Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Apr 1963. 6p. Dep. NTIS $4.00.

2803 COMETA: AN ULTRA-COARSE-MESH THREE-DIMENSIONAL DIFFUSION CODE. Bonalumi, R.; Giorcelli, M. M.; Vimercati, G. Trans. Amer. Nucl. Soc.; 20: 362-365 (Apr 1975).

From European nuclear conference, Paris, France (21 Apr 1975).

2804 CONTROL ROD PROGRAMMING IN MULTIZONE REACTOR CORES. Fadilah, S. M.; Lewins, J. Trans. Amer. Nucl. Soc.; 20: 374-375(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2805 ON THE CONNECTION BETWEEN THE NEUTRONIC AND DETECTION PROCESSES. Watson, F. V. (Rio de Janeiro Univ. (Brazil)). Atomkernenergie; 24: No. 4, 271-275(1974).

A simple method to analyze reactor noise experiments is presented. The basis of the proposed method is the proper connection made between the neutronic and detection processes through a non-homogeneous Poison distribution. Statistical functionals associated with the neutronics and detection can then be computed in separate steps. The method has proved particularly efficient in the analysis of moments-related experiments. (auth)

2806 OPTIMAL REACTOR CONFIGURATION YIELDING MAXIMUM POWER. II. Bartosek, V.; Zalesky, K. (Nuclear Research Inst., Rez, Czech.). Kernenergie; 17: No. 12, 373-376(Dec 1974).

Subject to the restraint of a maximum allowable power density, optimum reactor configurations (geometry or fuel concentration variable) are derived to give the maximum power. (LTN)

Reactor Components and Accessories

Refer also to abstracts 605, 1307, 1347, 1351, 1457–1460, 2668, 2706, and 2912.

2807 (AED-CONF-74-538-009) EXPERIENCE IN THE INDUCTIVE HEAT TREATMENT OF WELDED SEAMS AND CLADDINGS OF NUCLEAR REACTOR COMPONENTS. Mueller, H. H. 1974. 8p. (In German). INIS.

From international colloquium on welding in nuclear engineering; Duesseldorf, F.R. Germany (23 Oct 1974).

2 figs.; 8 refs. With abstract.

Reactor components such as pressure vessels and steam-to-steam heat exchanger often can not be completely finished in the factory for spacial and weight reasons, but must be prefabricated in two or three parts and then put together at the nuclear power plant. There are special conditions for the heat treatment of these welded seams. The inductive heating contributes considerably to the safety of welded joints in reactor buildings. The experience gained also enables a correct heat treatment to be used for even larger diameters and wall thicknesses of nuclear reactor components in the future. (GE)

2808 (AED-CONF-74-538-018) QUALITY ASSURANCE IN THE PREPARATION OF COMPONENTS FOR PRIMARY CIRCUITS OF NUCLEAR POWER PLANTS, PARTICULARLY IN THE PROCESSING OF WELDING ADDITIONAL MATERIALS. Schueler, R.; Austel, W.; Maidorn, C. 1974. 9p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F.R. Germany (23 Oct 1974).

6 figs.; 6 refs. Available from ZAED.

The quality assurance of welding additional materials is described taking the example of welding processes in the production of primary circuit components such as reactor pressure vessels. Besides the necessary programs, controls, and tests, there is a complete quality assurance documentation specification. In order to transfer the quality assurance to the fabrication, a detailed fabrication and testing plan has to be made. (GE)

2809 (AED-CONF-74-538-028) AN INSERVICE REACTOR REPAIR SIMULATION. Binkley, N. C.; Herrmann, R. W. (Babcock and Wilcox Co., Barberton, Ohio (USA)). 1974. 10p. INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

With abstract. Available from ZAED.

The simulated repair (welding work in this case) of a nuclear reactor system component was carried out without the requirement of a postweld heat treatment. The procedure is deemed safe for use on reactor vessels with low accessibility. Residual stresses have been analyzed and exact mechanical values are given. (GE)

2810 SPECIAL REQUIREMENTS OF NUCLEAR POWER STATIONS PIPEWORK SYSTEMS. Thies, J. (Motor-Columbus Ingenieurunternehmung A. G., Baden (Switzerland)). VGB Kraftwerkstechnik; 54: No. 12, 787-790(Dec 1974). (In German).

Today there is also a trend in Western European nations for the purchaser of nuclear power stations to design and to check pipework layout in accordance with the ASME code. The first step

in designing according to the ASME code is to determine to what class the calculations shall accord. The dynamic calculation of earthquakes presents certain difficulties, for assumptions have to be made which can, depending on the method of analysis, lead to the most variable results. (auth)

2811 SCATTERED LIGHT PROBE FOR THE DETERMINATION OF DROPLET SIZE AND MOISTURE IN TWO-PHASE FLOWS (STEAM PIPEWORK OF NUCLEAR POWER STATIONS, LOW PRESSURE STEAM TURBINES, COOLING TOWERS). Ederhof, A.; Dibelius, G. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Dampf- und Gasturbinen). VGB Kraftwerkstechnik; 55: No. 1, 61-66(Jan 1975). (In German).

At the Institute for Steam and Gas Turbines of the Rhine-Westfalia Technical High School in Aachen, the so-called "Scattered Light Probe" has been developed. This enables the amount of moisture, droplet size distribution and numbers of droplets to be measured. In addition the approximate speeds of individual droplets can be determined. This probe has been used for measurements on high-pressure steam pipework of saturated turbines, on low-pressure components of condensing turbines and also on natural draught wet cooling towers. The measuring principle, its limitations and its difficulties and designs of probe suitable for different applications are described. In addition the results of measurements are indicated and discussed. (auth)

2812 DESIGN CONSIDERATIONS FOR MEETING NUCLEAR SAFETY SYSTEMS SEPARATIONS CRITERIA. Damon, D. L. (Bechtel Power Corp., San Francisco). IEEE Trans. Nucl. Sci.; NS-22/ No. 1, 776-783(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The need for separation of redundant safety systems is well established; however, what constitutes an adequate separation is not. Adequate separation depends upon the nature of the hazards involved, and the vulnerability of the protected equipment. The most prevalent hazards are described and separations techniques, with respect to equipment vulnerability, to adequately ensure safety functions are discussed. 71 references. (auth)

2813 AGING OF CLASS 1E MODULES. McGrath, T. J. (Stone and Webster Engineering Corp., Boston). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 798-802(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Prevention of or elimination of common mode failure mechanisms which may compromise the independence of redundant safety systems for nuclear power generating stations is a design objective. Within the last two years degradation of safety equipment performance due to continuous long term exposure to service environment (aging) has been identified as a potential common mode failure mechanism. Consequently placing equipment in a condition representative of advanced age as part of a type test program is now required by IEEE 323, 1974. Some of the technology regarding placing equipment in an aged condition as well as some limitations of that technology as it applies to the nuclear power industry are discussed. These limitations are particularly important with regard to the extent of commitment to IEEE 323, 1974 possible by electric utilities. 24 references. (auth)

2814 EdF EXPERIMENTAL TEST FACILITIES FOR MAIN COMPONENTS OF NUCLEAR POWER STATION. Blanc-Feraud, P. Trans. Amer. Nucl. Soc.; 20: 48-49(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2815 LARGE STEAM TURBINES FOR NUCLEAR POWER STATIONS: OUTPUT GROWTH PROSPECTS. Riollet, G.; Widmer, M.; Tessier, J. Trans. Amer. Nucl. Soc.; 20: 52-53(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2816 6-MW ELECTRIC STEAM GENERATOR FOR STARTUP TESTS OF NUCLEAR PLANTS. Flinta, J. E.; Hernborg, G. Trans. Amer. Nucl. Soc.; 20: 158-160(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2817 QUALITY ASSURANCE IN THE MANUFACTURE OF TUBES FOR NUCLEAR SYSTEMS. Pethen, R. W.; Guest, J. C.; Marsh, D. M. Trans. Amer. Nucl. Soc.; 20: 567-570(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2818 RADIOCHEMICAL ANALYSIS OF THE PRIMARY COOLANT OF WATER COOLED REACTORS BY MEANS OF A Ge(Li) DETECTOR. Neeb, K. H.; Neidl, H.; Stoeckert, H. (Siemens A. G., Erlangen (F. R. Germany). Abt. Reaktortechnik). Siemens Forsch.-Entwicklungsber.; 1: No. 4, 350-354(1972). (In German).

An analysis scheme consisting of easy-to-carry out steps is described which combined with the Ge(Li) measuring technique permits the determination of all essential radionuclides in the primary circuit. Due to possible differences in the radiochemical composition of the primary coolant of various reactors, no detailed working rules are given. However, the principles as well as the possible disturbances and limits of the analysis procedure are indicated. The danger of a faulty assignment of the peaks occurring in the γ-spectra is practically eliminated by the separation process. Due to its simplicity, the necessary chemical and measuring technical operations can be quickly learned even by those having little training in radiochemistry. (GE)

2819 NEWLY DEVELOPED CONTROL AND STOP VALVES. Grotioh, K. (Sulzer Bros. Ltd., Winterthur (Switzerland)). Ind. At. Spatiales; 18: No. 4, 19-34(Jul 1974). (In French, English).

The most important new developments in control and stop valves are surveyed. The equipment described represents a sample from a very complex and ramified field. Special attention is paid to the gate valves and medium-actuated valves for nuclear power plants, with their stringent requirements in the way of operational dependability. (FR)

Reactor Fuels

Refer also to abstracts 199–208, 210, 211, 213–215, 384, 1281, 1319, 1321, 1323, 1331, 1333–1335, and 1509.

2820 (AED-CONF-74-571-003) REVIEW ON PLUTONIUM RECYCLING EXPERIMENTS AND PROGRAM IN JAPAN. Amanuma, T.; Akutsu, H.; Koizumi, M. 1974. 10p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

Programs for plutonium recycle in Japan are described. Included are the activities in the fields of fuel fabrication, reprocessing, extended irradiation tests, and critical experiments to measure reactor physics characteristics. Planned expansions of capacities of reprocessing and conversion plants are briefly explained. (GE)

2821 (AED-CONF-74-571-004) MAIN ACHIEVEMENTS IN ITALIAN PROGRAMS ON PLUTONIUM RECYCLE IN THERMAL REACTORS. Ariemma, A. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1974. 6p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).

A report is given on the state and results of the Italian test programs. The plutonium-island configuration is preferred for the replacement of Pu in boiling water reactors (Garigliano). Furthermore, a report is given on the planned ENEL activities in the field of Pu recycling. (GE)

2822 (AED-CONF-74-571-006) PRESENT STATUS OF THE PLUTONIUM PROGRAMME IN BELGIUM. Bairiot, H. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1974. 5p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

An outline of the plutonium fuel program in Belgium is given. All efforts have been focussed during the last three years on: (1) the gradual up-rating of capacities in the field of fuel manufacture; (2) the continuous improvement of design techniques and constructions; (3) the demonstration and investigation of the behavior of plutonium fuels in power reactors; and (4) the best utilization of the particular features of the plutonium fuel for improving the characteristics of the reloads by the additional flexibility obtained from the simultaneous presence of plutonium and uranium fuel within the reload. After having solved the technical problems, there still remain the problems of economical use, the establishment of confidence in the performance of these fuels, as well as appropriate application of safeguard regulations. (GE)

2823 (AED-CONF-74-571-014) STATUS OF PLUTONIUM FUEL UTILIZATION IN THE UNITED STATES. Hanrahan, E. J. (USAEC Office of Planning and Analysis, Washington, D.C.). 1974. 11p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).

1 ref.

A review is given on the development and demonstration programs as well as on the environmental problems connected with plutonium recycling. Furthermore, the state of development of legal specifications and instructions is reported. (GE)

2824 (AED-CONF-74-571-026) ELECTRIC POWER RESEARCH INSTITUTE — PROGRAMS ON PLUTONIUM FUEL UTILIZATION. Zolotar, B. A.; Lapides, M. E.; Gelhaus, F. E. 1974. 6p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).

Problems on the recycling of plutonium, its reusability in light water reactors and high temperature reactors, are influenced by many factors. In the USA, the Electric Power Research Institute is trying by a series of different research projects to find a technical basis which permits the nuclear industry to choose between different alternatives. Among the projects are the fabrication of various prototypes of BWR fuel element assemblies, as well as extended irradiation tests and reloading tests. Furthermore, there are projects in the field of fuel management and numerous programs on the usability of plutonium. The institute also carried out a series of Pu-recycle seminars whose aims and results are briefly outlined. (GE)

2825 (ORNL-TM-4867) MODIFICATION V TO THE COMPUTER CODE, STRETCH, FOR PREDICTING COATED-PARTICLE BEHAVIOR. Valentine, K. H. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 39p. Dep. NTIS $4.00.

Several modifications have been made to the stress analysis code, STRETCH, in an attempt to improve agreement between the calculated and observed behavior of pyrocarbon-coated fuel particles during irradiation in a reactor environment. Specific areas of the code that have been modified are the neutron-induced densification model and the neutron-induced creep calculation. Also, the capability for modeling surface temperature variations has been added. HFIR Target experiments HT-12 through HT-15 have been simulated with the modified code, and the neutron-fluence vs particle-failure predictions compare favorably with the experimental results. Listings of the modified FORTRAN IV main source program and additional FORTRAN IV functions are provided along with instructions for supplying the additional input data. (auth)

2826 IN-PILE DENSIFICATION OF URANIUM DIOXIDE Chernock, W. P.; Andrews, M. G.; Harkness, S. D. Trans. Amer. Nucl. Soc.; 20: 215-216(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2827 UO_2 DENSIFICATION: IRRADIATION RESULTS, LAWS, AND MODELS. de Contenson, G.; Lestiboudois, G.; Vignesoult, N. Trans. Amer. Nucl. Soc.; 20: 216-219(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2828 COMETHE III-G FOR FUEL ROD BEHAVIOR PREDICTION. Hoppe, N. Trans. Amer. Nucl. Soc.; 20: 219-220(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2829 THERMAL DEFORMATION OF UO_2 PELLETS IN A THIN-WALLED, NARROW-GAP FUEL PIN. Mishima, Y.; Okubo, T.; Wada, T.; Wakashima, Y. Trans. Amer. Nucl. Soc.; 20: 222-224(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2830 MECHANICAL BEHAVIOR OF A FUEL PIN UNDER IRRADIATION: FUEL CLADDING INTERACTION AT HIGH POWER RATE. Calza-Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Pesce, E.; Rocca, U.; Rotoloni, P. L. Trans. Amer. Nucl. Soc.; 20: 229-231(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2831 FUEL ELEMENT FAILURES CAUSED BY IODINE STRESS CORROSION. Videm, K.; Lunde, L. Trans. Amer. Nucl. Soc.; 20: 231-232(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2832 PELLET CLADDING MECHANICAL INTERACTION. Lunde, J. E. Trans. Amer. Nucl. Soc.; 20: 237(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2833 IRRADIATION BEHAVIOR OF VIBRASOL FUEL. Sens, P. F.; Majoor, E. B. M. Trans. Amer. Nucl. Soc.; 20: 238-239(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2834 FUEL PERFORMANCE IN ENEL POWER STATIONS. Ariemma, A.; Belelli, U.; Cometto, M.; Sani, L. Trans. Amer. Nucl. Soc.; 20: 251-252(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2835 EXPERIENCE OF POWER REACTOR FUELS IN JAPAN. Mishima, Y. Trans. Amer. Nucl. Soc.; 20: 257-258 (Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2836 BEST-6: A FLEXIBLE TOOL FOR OPTIMIZATION OF FUEL LOADING STRATEGIES. Civita, P.; Fornaciari, P.; Gangemi, F.; Mazzanti, T. Trans. Amer. Nucl. Soc.; 20: 383-384(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2837 FABRICATION OF VIBRASOL FUEL RODS. Sens, P. F.; Kanij, J. B. W.; Nater, K. A.; Verheugen, J. H. N. Trans. Amer. Nucl. Soc.; 20: 593-594(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2838 CONTROLLED POROSITY OXIDE FUEL. Rogan, H.; Heal, T. J.; Littlechild, J. E.; Raven, L. Trans. Amer. Nucl. Soc.; 20: 611-614(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2839 SPECIFICATIONS: ARE THEY ALL MEANINGFUL. Huet, J. J. Trans. Amer. Nucl. Soc.; 20: 617-618(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2840 TRANSIENT TEMPERATURE DISTRIBUTION IN A MULTICHANNEL COOLED, HEAT-GENERATING CYLINDER. Lin, K. J.; Chen, K. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 167-178(Dec 1974).

Alternating-direction method is used to solve the unsteady-state temperature distribution for a heat-generating circular cylinder cooled by a central channel surrounded by a ring of equally spaced circular channels. Numerical example is presented for a uniform heat-generating circular cylinder cooled by five channels. The temperature distribution inside the cylinder reaches steady state when $\tau \geq 1.0$. (auth)

2841 DETERMINATION OF BURN-UP OF IRRADIATED FUEL ELEMENTS BY PULSED NEUTRON INTERROGATION. Rotter, W. Ann. Nucl. Sci. Eng.; 1: No. 7/8, 451-458(Jul 1974).

An experimental study is described which could provide a method for the non-destructive assay of the fissile content in depleted fuel elements of power reactors. The basis of the method is a comparison of pulsed prompt neutron responses of the unknown fuel element with responses of known standards. The method has been tested on non-irradiated BR2 fuel elements simulating two types of examination: (a) determination of the remaining ^{235}U content and of the associated boron content (residual burnable poison); (b) classification of poisoned cermet elements with respect to increasing burn-up, without discrimination of uranium and poison effects. An installation is described which should allow determination of burn-up values up to 50% within reasonable measuring times and with acceptable accuracy. (auth)

Reactor Control Systems

Refer also to abstract 869.

2842 (AED-CONF-74-462-001) TASKS OF ANALYTICAL MEASURING TECHNIQUES FOR THE OPERATIONAL SAFETY OF NUCLEAR POWER PLANTS. Neff, H.; Neeb, K. H. (Karlsruhe Univ. (TH) (F. R. Germany). Fakultaet fuer Physik). 1974. 9p. (In German). INIS.

From INTERKAMA 74; Duesseldorf, F. R. Germany (10 Oct 1974).

With abstract. Available from ZAED.

A description is given of operational features of instrumentation in and outside the reactor core and in the environment of the reactor as well as the manual and automatic systems which are activated as soon as any abnormal operation is detected which endangers the reactor, the personnel, or the environment. Safety system performance in simulated dangerous failure situations and the on-line testing of safety system components are emphasized. (GE)

2843 (AERE-R-7809) COMPUTER BASED SAFETY SYSTEMS. Kenward, C. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1974. 32p. Dep. NTIS (US Sales Only) $4.00.

The principles involved in the construction of reliable controllers have been examined in some detail and it appears feasible

to incorporate computers into their design to give a greater flexibility of performance than would easily be available in a purely hard-wired system. Two main techniques are suggested to increase the system reliability. The first minimises the effect of hardware failures by using a conventional majority vote technique to extract corrected information from a number of redundant inputs. This corrected information is then redistributed among a similar set of output lines, a process which may be repeated more than once in a given controller. Secondly a dynamic checking system continuously probes the equipment for hardware faults. The fast replacement of failed equipment reduces the redundancy required for a given performance. One particular configuration, a set of four mini computers operating as a self checking group, has been selected for detailed examination in respect of random failures. It is shown that this configuration is very likely to possess a sufficient degree of reliability and availability to be used as part of the primary safety protection of a typical fast reactor. The remaining safety arguments centre around the probability of common mode failures due to design errors in either the software or the hardware. On the basis of qualitative arguments the computer based safety system is shown to have some advantages and disadvantages when compared with a hard wired safety system of equivalent complexity. The issue is a complex one and an experimental approach will be required to resolve this question. 10 references. (auth)

2844 (RT/ING-(74)15) ROLE OF DIGITAL AND HYBRID SIMULATION AS A TOOL IN DESIGNING A NUCLEAR PLANT CONTROL SYSTEM. Di Porto, P.; Vaccarino, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). May 1974. 26p. (CONF-730704-4). Dep. NTIS (US Sales Only) $4.50.
From computer simulation conference; Montreal, Canada (17 Jul 1973).

An integrated use of the digital and hybrid simulation in designing a nuclear reactor control system is described. The basic criteria used for defining the working areas and the models used on both machines are outlined. An analysis of the results is made with respect to time-saving and economy of this working criteria. (auth)

2845 (TID/SNA-1734) ENGINEERING OPERATIONS REPORT: I AND C SYSTEM DESIGN SUMMARY. Gilles, W. P. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1972. 65p. Dep. NTIS $6.25.

This report constitutes the design, as of March 1972, for the NERVA Instrumentation and Control System including block diagrams of the system and its components, a set of preliminary electrical interface drawings and preliminary design sheets for several components. The Instrumentation and Control (I&C) System was designed to have a simple one-wire functional interface with the nuclear stage. Simple commands such as "precondition," "start," and "shutdown" were all that would be required by the engine. The system was designed with a self-contained battery that permitted the engine to operate without imposing electrical energy demands on the state except during the latter portion of the pulse cooldown and during coast. Only the Data Acquisition System, the Data Control Unit, the Power Distribution Unit, and the Actuator Driver Unit were actively worked on during 1971 and 1972. Block diagrams and preliminary specifications for these components were completed and are included in this report. System design progressed to the point that it was concluded that the system was practical from a hardware viewpoint and that there was hope of meeting the reliability requirements. (auth)

2846 (TID/SNA-1737) ENGINEERING OPERATIONS REPORT: NERVA DIGITAL CONTROLLER/ACTUATOR DRIVER INTERFACE STUDY. Dowling, E. F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1972. 23p. Dep. NTIS $4.25.

In order to determine what signals should exist at the interface between the NERVA digital controller and the actuator drivers, a study was conducted comparing the overall system considerations of various interface concepts. The interface study was conducted by establishing evaluation criteria, proposing interface signal concepts, and evaluating the control systems resulting from the interface concepts against the criteria established. The evaluation criteria included system performance, complexity, and malfunction sensitivity. Three interface concepts were proposed based on the use of either rate or position commands to control the Drum, BCV, SSV, and PDCV actuators. The bulk of the analysis was conducted with a mathematical model consisting of the state variable controller, non-linear actuator models, and a simple, linear engine model. This work was confirmed by using the full scale E-1 CAM mechanized on the hybrid computer. System complexity and malfunction sensitivity were evaluated on a relative, qualitative basis. Either Concept 1 (position control) or Concept 2 (position/rate control) is acceptable for interfacing the digital controller with the actuator drivers. Concept 3 is not considered acceptable on the basis that rate control of the AC induction motor actuators has not yet been shown feasible. Other, more detailed conslusions are given. (auth)

2847 (TID/SNA-1746) DIRECT ITERATIVE DECOUPLING PROCEDURE FOR MULTIVARIABLE CONTROL SYSTEM DESIGN. Openshaw, F. L. 1972. 20p. Dep. NTIS $4.00.

A design technique has been developed, for a limited class of systems, which provides a state variable control design resulting in a decoupled, conditioned system. A controller was designed for both linear and non-linear fourth order models of a nuclear rocket engine. A direct non-linear control synthesis was performed. The non-linear control exhibited constant decoupled performance in control of the highly-coupled, non-linear engine model and exhibited a stable "type two" control response. (auth)

2848 (TID/SNA-1751) CERTAIN PERFORMANCE CHARACTERISTICS OF THE E-1 CAM STATE VARIABLE FEEDBACK CONTROL SYSTEM. Parziale, E. A.; Schenz, R. F. Jr. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 10 May 1971. 16p. Dep. NTIS $4.00.

Certain performance characteristics of the E-1 CAM state variable feedback control system are documented. Treatment is given to (1) dynamic response comparison between open loop and closed loop systems during thrust buildup, (2) sensitivity to deviations of open loop demands from their nominal trajectories, and (3) effect of single feedback signal loss on performance. (auth)

2849 (TID/SNA-1752) COOLDOWN CONTROLS FUNCTIONAL DESIGN. Saluja, J. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 26 Jan 1972. 23p. Dep. NTIS $4.25.

The objective of the effort reported is to develop a controls design for the NERVA engine in the cooldown phase of operation which meets the performance requirements of References 1 and 6. The preliminary cooldown controls functional design and the status of the design effort to date is documented. The completion of this effort as outlined in the work statements will culminate in a first cut design which may not be optimized and which will not include any malfunction analysis. A description of the cooldown phase of engine operation is given in Section 2, whereas Section 3 deals in some detail with the main topic of cooldown controls. The control concept is described, the control system functional block diagram and the controller logic are given and the cooldown predictor model is described. Section 4 shows some preliminary results obtained with the PRECUR model and the cooldown predictor model. Section 5 briefly states the conclusions and the work remaining to be done towards the development of the cooldown controller. (auth)

2850 (TID/SNA-1759) STARTUP CONTROLS DESIGN. Openshaw, F. L.; Parziale, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 28 Oct 1971. 80p. Dep. NTIS $7.00.

The startup control system design effort which began in June assumed a reference startup method which employed the powered chill approach during temperature conditioning. Due primarily to the high penalty in propellant utilization with this approach, the "pressure chill" concept has been proposed. This redefinition of the reference startup method has a major impact on present startup work and a revised work plan and schedule must be determined to reflect the change. The purpose of this memorandum is to document the startup work done to date in accordance with the original work plan. The work plan and schedule are given with the work accomplished to date indicated. Documented within are the limited set of initial conditions which were to be considered in the first phase of the startup controls design work. A description of the startup supervisory logic, startup sequencing, and the startup digital control program are contained along with an ambient startup response employing analog controls and sequencing. (auth)

2851 (TID/SNA-2199) ENGINEERING OPERATIONS REPORT: SHUTDOWN CONCEPTS EVALUATION. Pasternak, T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1972. 91p. Dep. NTIS $7.75.

The superiority of the nuclear rocket over chemical rockets over chemical rockets can be reduced considerably if the specific impulse is degraded by ineffective use of propellant during reactor shutdown. The payload carrying ability can be reduced appreciably by such non-optimum use of propellant (the payload penalty varies with the mission but can be as much as several thousand pounds). After a NERVA reactor has operated at a chamber temperature of 4250°R for a few seconds, the propellant flow must be reduced gradually (4250°R to 1760°R in about 150

seconds, never exceeding 50°R/sec.) so that critical components (steam liners, nozzle tubes, reflector wrapper) do not exceed permissible material temperatures. Optimum procedures for removing the heat from delayed neutrons, gamma decay and thermal heat in the engine are discussed. A complicating factor is turbopump instability at low flows. Reactor shutdown is defined to end at 1500–1700°R after which the engine temperature is controlled by pulse cooling. (LTN)

2852 (WANL-TME-255) SPECIFICATION, NUCLEAR INSTRUMENTATION SYSTEM FOR NRX-A CONTROL SYSTEM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Jan 1963. 15p. Dep. NTIS $4.00.

2853 (WANL-TME-294) PRELIMINARY ESTIMATE OF CONTROL SYSTEM SPACE AND CABLE REQUIREMENTS AT ETS-1 TEST CELL. Welsh, R. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Mar 1963. 6p. Dep. NTIS $4.00.

2854 (WANL-TME-1157(Rev.A)) NRX/EST CONTROLS AND FACILITIES FAILURE MODE ANALYSIS. Wagner, G. L.; McLane, F. E.; Gormley, O. P.; Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Aug 1965. 15p. Dep. NTIS $4.00.

Specific control subsystems, which may be added to the NRX/EST control system, are described (Revision A) and subjected to failure mode analysis (pressure control loop). (LTN)

2855 (WANL-TME-1157(Rev.B)) NRX/EST CONTROLS AND FACILITIES FAILURE MODE ANALYSIS. Wagner, G. L.; McLane, F. E.; Gormley, O. P.; Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Sep 1965. 29p. Dep. NTIS $4.50.

Specific control subsystems, which may be added to the NRX/EST control system, are described (Revision B) and subjected to failure mode analysis (on-off power controller, coupling of temperature and pressure loops, limiter circuits and a data programmer). (LTN)

2856 (WANL-TMI-1519) PROPOSED DRUM ACTUATOR AND CONTROL SYSTEM FOR THE NRX-A7 REACTOR. Walsh, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Jul 1965. 65p. Dep. NTIS $6.25.

A method of control for the NRX-A7 reactor consisting of an ON-OFF controller with slow, constant speed, open loop, pneumatic actuators and mechanically coupled drums is proposed. The ON-OFF controller is similar to that planned for the NRX/EST and NRX-A5 reactor tests. Two types of pneumatically-operated actuators have been conceptually designed and implement the ON-OFF constant velocity control by either gas flow control or pressure control. Both actuators operate independent of a feedback signal although a potentiometer should be used to report drum position for analysis and malfunction purposes. In addition, each actuator system uses high force solenoids in lieu of torquemotors, a distinct reliability advantage. With excess force designed into the solenoids, degradation of the magnetic materials can occur under radiation without influencing the operating performance. A considerable simplification in design and increase in reliability results with the use of solenoids since performance is less dependent on temperature as small changes in air gaps are of minor influence. Analog computer performance studies are reliability evaluations were made for the control and actuation system. The results of the studies and evaluations indicate a marked reliability improvement over the present control and actuation systems. The flow control actuator is recommended over the pressure control type since it features simpler construction, incorporates many firmly established design features of the AG-20 pneumatic actuator, and only requires about half the pneumatic force resulting in a corresponding reduction in size and weight of components. (auth)

2857 (WANL-TMI-1569) NRX/EST CONTROL SYSTEM OPERATION AND DESCRIPTION. Walsh, J. M.; Hohmann, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. 17p. Dep. NTIS $4.00.

The NRX/EST Control System, as shown in WANL Drawing 710J659, is described and operating procedures explained. The EST control system consists of pressure, flux, and temperature control loops with temperature to pressure slaving. These control loops are supplemented by flux, temperature, and pressure to temperature cross loop limiter controls. The EST control system includes a turbine power control valve (TPCV) auto start circuit, in addition to the reactor automatic startup control. The TPCV auto start or "schedular" circuit is used to open the TPCV on a preset profile to a desired level in much the same way as the reactor auto start circuit moves the control drums and establishes a predetermined power level. Operation of the EST controls are described for normal and alternate bootstraps, no flux control, on-off temperature control, endurance run, and system mapping and dynamic tests. (auth)

2858 (WANL-TMI-1860) XE-1 CONTROL DRUM BEARING TEST. Solie, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Dec 1967. 18p. Dep. NTIS $4.00.

Debris was found on the XE-1 nozzle end ring adjacent to the integral control drum bearing housings during routine operations at NRDS. It was assumed that some debris could have entered the bearings and control drum annulus. Therefore, a series of control drum torque tests was performed at reactor temperature and simulated pressure conditions to determine whether the control drum assembly would operate satisfactorily when contaminated with debris. To establish a base line torque, a test without debris was performed on the control drum assembled with a new reactor grade bearings. The maximum torque was 5 in.-lbs. Debris from the XE-1 reactor was then inserted into the control drum through the aft bearing and housing to simulate a condition that could exist in the XE-1 reactor. Cycling tests were performed on the control drum and the maximum torque recorded was 21.5 in.-lbs. At the end of the test, after additional various cycling tests, the torque had reduced to 15 in.-lbs. Based on results of this test, the XE-1 control drum bearings should function satisfactorily. (auth)

2859 (WANL-TMI-1985) SOME NEUTRON TRANSMISSION MEASUREMENTS ON NERVA REACTOR CONTROL VANES. Roesmer, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1969. 25p. Dep. NTIS $4.25.

The neutron transmission data indicate that boron is homogeneously distributed across the length of each CuB vane measured. The question whether the boron in the vanes is enriched in B^{10} or has its natural isotopic composition cannot be answered unambiguously at this time. To do so, the energy distribution of the hardened neutron spectrum of the final experimental setup must be known. Attempts were made to correlate the transmittance of ½-inch by ½-inch sections of CuB vanes with their boron concentration, determined by conventional wet chemical analysis. A calibration curve could have been developed if the dimensions of the analyzed CuB standards were ½-inch by 3½ inch, i.e., approached the width of a CuB vane. Apparently, the shape of the neutron energy spectrum is rather nonuniform across the central opening in the moderator. This fact is a further reason to measure the neutron energy distribution as a function of position across the central opening in the moderator. Transmission measurements could be made more meaningful if the source-moderator geometry were changed such that there is no position dependence of the neutron energy distribution above the central opening in the moderator. (auth)

2860 (WANL-TMI-2008) XE PRIME TEMPERATURE CONTROLLER. Walsh, J. M.; Cooper, K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 May 1970. 70p. Dep. NTIS $6.50.

The performance of the XE temperature control systems is summarized. The performance of two temperature controllers, the state programmed and on-off controllers, were tested during the XE test series. Test data in the form of transient response and frequency responses were obtained and are used to evaluate the performance of these controllers. In addition to the frequency response data which were measured in temperature control, frequency response data were also obtained in the position control mode. All together frequency response information at six operating or state points were obtained and are used to evaluate the temperature controllers. While the single range temperature controller was not tested, the frequency response data obtained during the test series can be used to evaluate this controller. (auth)

2861 OPTIMAL CONTROL OF A LARGE CORE REACTOR IN PRESENCE OF XENON. Tsouri, N. (Columbia Univ., New York); Rootenberg, J.; Lidofsky, L. J. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 702-710(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Changes in power level of large-core reactors are always accompanied by subsequent (transient as well as steady-state) changes in the concentration of xenon. This, in turn, necessitates long-term control-rod operations to control the so-called "xenon oscillations". A method, based on optimal control theory, is presented to minimize the undesirable xenon oscillations. It involves the programming of the reactivity changes necessary to accomplish the power level change, while minimizing the deviations of the power level as well as the xenon and iodine concentrations, from their final values. In accordance with optimal control theory and for an adequate problem formulation, a performance index is defined. The "penalty" associated with the deviations of the neutron flux, xenon and iodine concentrations, from their final

values is to be minimized. A novel approach to bypass the difficulties encountered in the numerical solution of the resulting nonlinear Two Point Boundary Value Problem (TPBVP) is presented. The method uses a hierarchical structure to replace the actual nonlinear system by a set of sub-systems. The TPBVP for each subsystem is solved using the solution of the preceding one. This iterative method is discussed and is shown to achieve rapid convergence. Furthermore, the method reduces the amount of computational work needed, thus making it suitable for a minicomputer control application. The procedure described above yields a long-term optimal control law u*(t), i.e., a trajectory of the reactivity u(t) that when followed will minimize the integral of the state deviations, as well as the time needed to reach the new steady-state. 9 references. (auth)

2862 COMPUTER BASED DESIGN OF A POWER PLANT CONTROL CENTER. Myers, J. E. Jr.; Shultz, T. G. (Combustion Engineering, Inc., Windsor, CT). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 759-765(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Digital computer systems can provide an efficient means of accessing, correlating, and displaying plant information to the operator. The careful application of human engineering techniques is required to effectively utilize this information. A total systems approach which includes the implementation of redundant subsystems is necessary to maintain high reliability and availability. The design of such a system is described. 6 references. (auth)

2863 DESIGN CONSIDERATIONS FOR MEETING SEPARATION CRITERIA FOR CLASS 1E SYSTEMS WITHIN THE CONTROL BOARD. Burn, R. R. (General Atomic Co., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 772-775(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The logic diagram for an engineered safety features protection system is shown. The engineered safety feature system is similar for Babcock and Wilcox, Combustion Engineering, General Atomic, General Electric, and Westinghouse. As a result, the system is used to illustrate the design considerations and techniques for meeting separation criteria for Class 1 systems. The engineered safety features system employs local coincidence logic. The system uses transmission logic, i.e., the transmission of electric power is required to initiate protective action. Transmission logic is used to prevent unwanted actuation of engineered safety features in the event of loss of electric power or safe channel failure. The system has three instrument channels for each variable. Bistable trip signals from the three instrument channels for each variable are fed to two two-of-three logic matrices; one for logic channel A and one for logic channel B. Two-of-three logic matrices are provided for each variable in both logic channels. The output of each two-of-three logic matrix is transmitted to a one-of-one logic matrix or actuator module which acts to transmit power to engineered safety feature equipment. Either output logic channel is capable of actuating the engineered safety features. In logic language, a one-of-three logic arrangement of three sets of three instrument trip signals and a one-of-one logic arrangement of two logic channels and electrical energizing signals initiate the engineered safety features actuation. 4 references. (auth)

2864 OCONEE NUCLEAR STATION CONTROL, INSTRUMENTATION, AND ELECTRICAL SYSTEM OPERATING EXPERIENCE. Bradham, O. S.; McMeekin, T. C. (Duke Power Co., Charlotte, NC). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 808-811(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The Oconee Nuclear Station, a three unit station, is Duke Power Company's first nuclear generating facility. Selected control, instrumentation and electrical system operating experience is provided. (auth)

2865 SUBOPTIONAL CONTROL STUDY OF A NUCLEAR POWER PLANT. Tepper, L. IEEE Trans. Nucl. Sci.; NS-22: No. 1, 812-819(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

Concepts of modern control theory and, in particular, of optimal control have been used to develop a general and systematic method of regulator design starting from the non-linear mathematical model of the plant. This method was applied to the study of the control of a nuclear reactor plant of the SGHWR type (steam generating heavy water reactor), of 105 MW-electric power, working at the Atomic Energy Authority Establishment, Winfrith, Dorset, England. The optimal linear regulator, computed for the free system, is incorporated into the system with saturation limits on its control inputs. This is one reason for suboptimality. Then only measurable state variables carrying large amounts of feedback control (compared with the rest of the variables) were used on the regulator, hence the second reason for suboptimality. In the course of this work a new method of optimal linear regulator design for external disturbances was applied. It is computationally very simple and also permits a simple calculation of transients by using the same eigenvector matrix regardless of the disturbance. 22 references. (auth)

2866 LARGE HTGR CONTROL ROOM DESIGN. Dalry, R. H. (General Atomic Co., San Diego, CA). IEEE Trans. Nucl. Sci.; NS-22: No. 1, 766-771(Feb 1975).

From 21st nuclear science symposium; 14th scintillation and semiconductor counter symposium; 6th nuclear power systems symposium; Washington, DC (11 Dec 1974).

The standard HTGR control room arrangement is based on an extensive program that started with a study of human engineering principles and evolved with the use of a full-scale mock-up employed to arrive at an optimized control board layout and select proper components for the man-machine interface. The integrated control system makes extensive use of a dual computer as a tool for data collection, alarming, and formating information for the operator, using cathode ray tubes (CRTs) as the prime display. Window type annunciators, recorders, and large pistol-grip switches have been replaced by multicolor CRTs, line printers, and miniature pushbutton switches designed into a compact monitoring and control console. The console is designed for stand-up and sit-down operation and is shaped for maximum operator convenience. Indicators and controls are functionally arranged so the operator can easily scan, compare like parameters, and respond to abnormal conditions. A summary is presented of the features General Atomic has included in the HTGR control room design and of approaches used to develop a modern design that meets General Atomic's objectives as well as current regulatory and code requirements. (auth)

2867 COMPUTER-BASED ADVANCED CONTROL ROOM FOR THE ALAN R. BARTON NUCLEAR PLANT. Hendon, H.; Hill, W.; Fiedler, M. Trans. Amer. Nucl. Soc.; 20: 46-48(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2868 FAST SHUTDOWN DEVICE USING LIQUID RODS FOR THE ESSOR REACTOR. Broggi, A.; Ragusa, S. Trans. Amer. Nucl. Soc.; 20: 58-61(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2869 TIHANGE NUCLEAR PLANT: POWER DISTRIBUTION CONTROL. Gouffon, A.; Lecocq, J. M. Trans. Amer. Nucl. Soc.; 20: 152-153(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

Nuclear Power Plant Economics

2870 (AED-CONF-74-435-003) THERMAL ENERGY STORAGE FOR THE ECONOMIC PEAK CURRENT GENERATION FROM NUCLEAR POWER PLANTS. Beckmann, G.; Fritz, K.; Gilli, P. V. (Waagner-Biro A.G., Vienna (Austria)). 1974. 11p. (In German). INIS.

From meeting on storage systems for secondary energy; Stuttgart, F.R. Germany (2 Oct 1974).

9 figs.; 2 tabs.; 13 refs. Published in VDI (Ver. Dtsch. Ing.) Ber. (1974) no. 223 pp. 21-31.

Following a brief review on the storage possibilities known today, the details and manner of operation of a nuclear peak load power plant is described. In the framework of an economical consideration, the costs of various power plants are compared to one another. (GE)

2871 CONSTRUCTION COSTS AND MANPOWER PERFORMANCES FOR CURRENT U. S. NUCLEAR PLANTS. Richardson, J. A. Trans. Amer. Nucl. Soc.; 20: 23-29(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2872 UTILITY'S MAIN TASKS IN CORE MANAGEMENT AND RELATED CALCULATION CAPABILITY. Ariemma, A.; Gualandi, M. P.; Zaffiro, B. Trans. Amer. Nucl. Soc.; 20: 352-353(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2873 OPTIMAL REACTOR STRATEGY TOWARD LONG-RANGE ENERGY INDEPENDENCE. Schikorr, W. M. Trans. Amer. Nucl. Soc.; 20: 396-398(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2874 NUCLEAR FUEL FABRICATION IN INDIA. Rao, N. K. Trans. Amer. Nucl. Soc.; 20: 407-410(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2875 EFFECT OF HTRs ON POWER PLANT INSTALLATION POLICIES. Conti, F.; Graziani, G.; Maineri, M.; Rinaldini, C.; Zanantoni, C. Trans. Amer. Nucl. Soc.; 20: 411-413(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2876 POWER MODULATION FOR NUCLEAR POWER STATIONS SUPPLYING ELECTRIC POWER OR HEAT DISTRIBUTION NETWORKS. Tillequin, J. Trans. Amer. Nucl. Soc.; 20: 736-738(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2877 ECONOMIC OUTLOOK FOR NUCLEAR REACTORS IN THE PROCESS STEAM MARKET. Thiriet, L. Trans. Amer. Nucl. Soc.; 20: 738-740(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2878 ECONOMIC COMPETITIVENESS OF A SINGLE-PURPOSE HEATING REACTOR FOR DISTRICT HEATING. Tarjanne, R.; Vuori, S. Trans. Amer. Nucl. Soc.; 20: 740-742(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2879 AGRO-POWER-WASTE COMPLEX. Schultz, M. A.; Witzig, W. F. Trans. Amer. Nucl. Soc.; 20: 742-746(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2880 CAPITAL NEEDS AND FINANCIAL REQUIREMENTS FOR PROGRAMS OF NUCLEAR PLANT CONSTRUCTION IN VARIOUS COUNTRIES. Williams, I. G. K.; Haeussermann, W. Trans. Amer. Nucl. Soc.; 20: 805(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2881 FINANCING PROBLEMS OF THE UTILITIES. Hausner, O. Trans. Amer. Nucl. Soc.; 20: 805-807(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2882 GLOBAL MANPOWER REQUIREMENTS FOR PROJECTED NUCLEAR PROGRAMS. Hammond, S.; Lane, J. A.; Rogov, A.; Skjoldebrand, R. Trans. Amer. Nucl. Soc.; 20: 813-815(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2883 UNIVERSITY RESPONSE TO MANPOWER NEEDS IN THE DEVELOPMENT OF NUCLEAR ENERGY. Kerr, W. Trans. Amer. Nucl. Soc.; 20: 815-817(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2884 NUCLEAR TRAINING IN A PUBLIC UTILITY. Myerscough, P. B. Trans. Amer. Nucl. Soc.; 20: 817-819(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2885 HOW TO SATISFY MANPOWER REQUIREMENTS: THE VIEWPOINT OF INDUSTRY. de Ladonchamps, J. Trans. Amer. Nucl. Soc.; 20: 819-820(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2886 INFORMATION OF THE GENERAL PUBLIC. Lindackers, K. H.; Rudloff, W. Trans. Amer. Nucl. Soc.; 20: 820 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2887 NUCLEAR ENERGY, SOLUTION TO THE ENERGY CRISIS. Wyart, P. (Organisation des Producteurs d'Energie Nucleaire (O. P. E. N.), 75 - Paris (France)). Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.); No. 108, 5-12(Jul 1974). (In French).
From plenary session of the ANS Belgian section; Mol, Belgium (6 Jun 1974).

The energy situation and its prospects are briefly outlined. A calculation of fuel costs in nuclear stations is attempted (extraction and concentration of ore in the form of U_3O_8, conversion of U_3O_8 into UF_6, enrichment to 3%, manufacture of fuel elements, fuel reprocessing, conditioning and storage of wastes). The organization of the nuclear fuel cycle in time is then examined after which the problems connected with enrichment (price per WU; declarations made at the Reston Atomic Industrial Forum Congress) and finally the role of electricity producers and NEPO are discussed. (FR)

2888 L'EUROPE ET L'ENERGIE NUCLEAIRE. (Europe and Nuclear Energy). Albonetti, A. Cahiers Atlantiques. Paris; Institut Atlantique des Affaires Internationales (1972). 85p. (In French).
Also published in English.
The present situation is reported: nuclear organization in the leading European countries; European collaboration in the nuclear field. The basic nuclear sectors involved in electrical energy production are then reviewed: natural and enriched uranium; nuclear reactors; nuclear fuel reprocessing. An energy policy for Europe is analyzed in conclusion. (FR)

Reactor Fuel Cycle Economics

Refer also to abstract 2344.

2889 (AED-CONF-74-571-009) REMARKS ON THE EVOLUTION OF THE PLUTONIUM PRICE. Bendell, F. 1974. 7p. (In French). INIS.
From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).
. fig.; 1 tab.; 6 refs. Available from ZAED.
Following an introduction into the fundamental details of the production and use of Pu, an estimate of the future price development is given based on the supply and demand up to 1990. Furthermore, the equilibrium price for LWR and FBR is assessed. (GE)

2890 REFUELING POLICY AND ELECTRICAL NETWORK NEEDS. Peltier, A.; Millat; Brandt. Trans. Amer. Nucl. Soc.; 20: 387-388(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2891 METHOD OF SHORT-RANGE SYSTEM ANALYSIS FOR NUCLEAR UTILITIES. Eng. R.; Mason, E. A. Trans. Amer. Nucl. Soc.; 20: 388-391(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2892 FUEL MANAGEMENT AND LOAD OPTIMIZATION FOR NUCLEAR UNITS IN ELECTRIC SYSTEMS. Grossman, L. M.; Reinking, A. G. Trans. Amer. Nucl. Soc.; 20: 391-393 (Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2893 SIMULATION STUDY ON LONG-TERM FUEL CYCLE DYNAMICS. Yamaji, K.; Kondo, S.; An, S. Trans. Amer. Nucl. Soc.; 20: 395-396(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2894 FUEL UTILIZATION OF REACTOR TYPES. Jirlow, K. Trans. Amer. Nucl. Soc.; 20: 401-402(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2895 ENERGY BALANCE IN LWR AND LMFBR BURNUP AND PRODUCTION OF FISSILE NUCLEI. Schwartz, J. P.; Ravier, J. Trans. Amer. Nucl. Soc.; 20: 402-404(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2896 PRESENT SITUATION AND FUTURE PROSPECTS OF THE NUCLEAR FUEL CYCLE IN MEXICO. Becerril, I.; de la Fuente, H.; Ortega, R. F. Trans. Amer. Nucl. Soc.; 20: 404-407(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2897 FINANCING OF THE NUCLEAR FUEL CYCLE. Wyart, P. Trans. Amer. Nucl. Soc.; 20: 807-808(Apr 1975).
From European nuclear conference; Paris, France (21 Apr 1975).

2898 NEUTRON ECONOMY AND CANADA'S LONG-TERM APPROACH TO NUCLEAR POWER. Hare, M. G. (Atomic

Energy of Canada Ltd., Pinawa, Manitoba). Eng. J. (Montreal); 57: No. 7, 91-94(1974).

Canada has approximately 20% of the world's supply of uranium at current prices. The neutron economy of a CANDU reactor is better than that of PWR breeder reactor; it is therefore able to burn natural uranium fuel. No new reactor technology would be needed to recycle plutonium and/or burn thorium if this were necessary as a result of increases in uranium costs. (CA)

Reactor Licensing and Regulation

Refer also to abstracts 2700 and 2763.

2899 (DOCKET-50537-1) CLINCH RIVER BREEDER REACTOR PLANT. License Application, Statement of General Information. (Project Management Corp., Chicago, Ill. (USA)). 7 Apr 1975. 284p. Dep. NTIS $17.25.

Application is made for a reactor facility consisting of a liquid metal cooled reactor and steam generator system, a steam turbine driven electric generating system, electrical switchyard, and related auxiliaries and supporting structures. The primary system is located in an inert atmosphere in shielded vaults within a containment structure. Sodium coolant is used to remove heat from the core and radial blanket. Heat from the primary sodium is transferred in heat exchangers to non radioactive sodium which is used to convert feed-water into steam which is superheated to drive a tandem-compound generator. A single shaft multi-stage turbine generator produces 380 MW(e) with steam conditions of 1450 psig at 900°F. Fuel is sintered ceramic pellets of mixed uranium-plutonium oxides encapsulated in stainless steels. There are 198 fuel assemblies with each assembly consisting of 217 fuel rods placed in a hexagonal channel. Plutonium enrichment ranges from 1817 to 32.0 percent by weight. Axial blanket sections contain depleted UO_2 with 99.9 percent ^{238}U and 0.2 percent ^{235}U by weight. The proposed location of the plant is within the corporate limits of the city of Oak Ridge in Roane County, Tennessee. (FS)

2900 (DOCKET-RM-50-1) CONCLUDING STATEMENT OF POSITION OF THE REGULATORY STAFF. Public Rulemaking Hearing On: Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Cooled Nuclear Power Reactors. (USAEC, Washington, D. C.). 16 Apr 1973. 224p. Dep. NTIS $14.25.

2901 (DOCKET-RM-50-1(App.)) IN THE MATTER OF RULEMAKING HEARING: ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. Opinion of the Commission. (USAEC, Washington, D. C.). 28 Dec 1973. 140p. Dep. NTIS $10.00.

2902 (DOCKET-RM-50-1(Suppl.)) TESTIMONY OF THE AEC REGULATORY STAFF AT A PUBLIC RULEMAKING HEARING ON INTERIM ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER POWER REACTORS. (USAEC, Washington, D. C.). 27 Jan 1972. 181p. Dep. NTIS $12.25.

Information is presented concerning the interim acceptance criteria, PWR evaluation models, and BWR evaluation models. (DCC)

2903 (DOCKET-RM-50-1(Suppl.1)) SUPPLEMENTARY CONCLUDING STATEMENT OF POSITION OF THE REGULATORY STAFF. Public Rulemaking on Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Nuclear Power Reactors. (USAEC, Washington, D. C.). 9 Aug 1973. 15p. Dep. NTIS $4.00.

2904 (DOCKET-RM-50-1(Supp.2)) SUPPLEMENTAL TESTIMONY OF THE AEC REGULATORY STAFF. Public Rulemaking Hearing on: Interim Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Cooled Power Reactors. (USAEC, Washington, D.C.). 26 Oct 1972. 313p. Dep. NTIS $18.75.

Information is presented concerning sensitivity analysis, loop codes, two-phase pressure drop, critical flow model, pump modeling, PWR core flow distribution, accumulator bypass, fuel densification, gap thermal conductance and UO_2 thermal conductivity, transition boiling heat transfer, clad-to-fluid heat transfer, heat transfer at low pressure, reflood rate analyses, containment back pressure during reflood, BWR FLECHT, PWR reflooding heat transfer FLECHT data, embrittlement and post-blowdown loads, fuel rod physico-chemical reactions, flow blockage, small break analysis, and decay heat. (DCC)

2905 (DOCKET-RM-50-1(Vol.1)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION: ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. (USAEC, Washington, D. C.). 9 May 1973. 160p. Dep. NTIS $11.00.

Information on the ECCS requirement for PWR and BWR reactors are presented concerning environmental impact, alternatives, adverse environmental effects, relationship between short-term uses of the environment and long-term productivity, irreversible and irretrievable commitment of resources, cost-benefit analysis, and discussion of significant comments received on the draft environmental statement. (DCC)

2906 (DOCKET-RM-50-1(Vol.2)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION: ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. (USAEC, Washington, D.C.). 9 May 1973. 340p. Dep. NTIS $20.00.

2907 (DOCKET-RM-50-1(Vol.3)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION: NUMERICAL GUIDES FOR DESIGN OBJECTIVES AND LIMITING CONDITIONS FOR OPERATION TO MEET THE CRITERION "AS LOW AS PRACTICABLE" FOR RADIOACTIVE MATERIAL IN LIGHT-WATER-COOLED NUCLEAR POWER REACTOR EFFLUENTS. Volume 3. Comments on the Draft Environmental Statement and Staff Responses Thereto. (USAEC, Washington, D. C.). Jul 1973. 332p. Dep. NTIS $19.75.

2908 (DOCKET-RM-50-2) CONCLUDING STATEMENT OF POSITION OF THE REGULATORY STAFF. Public Rulemaking Hearing on: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors. (USAEC, Washington, D.C.). 20 Feb 1974. 332p. Dep. NTIS $19.75.

2909 (DOCKET-RM-50-2(Dr.)) ATTACHMENT TO CONCLUDING STATEMENT OF POSITION OF THE REGULATORY STAFF. Public Rulemaking Hearing On: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors. (USAEC, Washington, D. C.). 20 Feb 1974. 466p. Dep. NTIS $26.50.

The staff has developed the attached five draft Regulatory Guides which provide models and parameters acceptable to the Regulatory staff for calculating average expected releases of radioactive materials in liquid and gaseous effluents and calculational models and assumptions used to estimate radiation doses for the purposes of implementing the guidance on design objectives and limiting conditions of operation in Appendix I. These draft Regulatory Guides are being made available as an attachment to the Concluding Statement. Concurrently with the adoption of a final rule by the Commission, the Regulatory Guides would be issued by the Director of Regulatory Standards. (auth)

2910 (FIND-STN-50482) FIND: WOLF CREEK GENERATING STATION, UNIT 1. Williams, W. H. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). May 1975. 29p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

2911 (FIND-STN-50483) FIND: CALLAWAY PLANT, UNITS 1 AND 2. Hendricks, P. L. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). May 1975. 34p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

2912 (RDT-E-15-2ND-T(3-75)) CLASS 3 NUCLEAR COMPONENTS (SUPPLEMENT TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, SUBSECTIONS NA AND ND). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 8p. RSO Free.

This standard supplements the rules for the construction of nuclear components that are covered by Subsections NA and ND of the 1974 Edition of the ASME Boiler and Pressure Vessel Code (the Code), Section III. When this standard is invoked or referenced, the applicable subsections of Section III of the Code are

also invoked or referenced. The user is responsible for obtaining and applying the edition and revisions of this standard that supplement the edition and Addenda of the Code that are in legal effect at the time of use. (auth)

2913 (REG/G-1.84(Rev.1)(4-75)) CODE CASE ACCEPTABILITY. ASME Section III Design and Fabrication. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Apr 1975. 5p. NRC.

This regulatory guide lists those Section III ASME Code Cases oriented to design and fabrication that are generally acceptable to the NRC staff for implementation in the licensing of light-water-cooled nuclear power plants. (auth)

2914 (REG/SRP-17.1) QUALITY ASSURANCE DURING DESIGN AND CONSTRUCTION. (USAEC Directorate of Licensing, Washington, D. C.). 1974. 20p. NRC.

A standard review plan for quality assurance during the design and construction of nuclear power plants is presented. (JWR)

2915 (WANL-TME-353) TABULATION OF DOSE RATES FROM MAXIMUM CREDIBLE ACCIDENTS AT WALTZ MILL. Arnold, W. H. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 May 1963. 4p. Dep. NTIS $4.00.

Maximum credible accident fission product releases are tabulated for various Westinghouse licensed facilities (critical experiments) at Waltz Mill, Pa. The doses are estimated at 2000, 3000 and 6500 feet as cloud dose, fallout dose and inhalation dose. (LTN)

2916 IT'S TIME TO SETTLE DOWN. Salvatori, R.; Giglio, J. M. Trans. Amer. Nucl. Soc.; 20: 442-444(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2917 INTERNATIONAL COOPERATION IN LICENSING OF NUCLEAR POWER PLANTS. Vinck, W. Trans. Amer. Nucl. Soc.; 20: 771-772(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2918 EXPERIENCE IN THE FEDERAL REPUBLIC OF GERMANY: CENTRALIZED VERSUS DECENTRALIZED LICENSING PROCEDURES. Sahl, W. Trans. Amer. Nucl. Soc.; 20: 772-773(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2919 PRACTICE AND EVOLUTION OF LICENSING PROCEDURES AND OF NUCLEAR REGULATION IN FRANCE. Servant, J. Trans. Amer. Nucl. Soc.; 20: 773-774(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

2920 REACTION OF THE PUBLIC TO THE LICENSING PROCEDURE. Courvoisier, P. Trans. Amer. Nucl. Soc.; 20: 774(Apr 1975).

From European nuclear conference; Paris, France (21 Apr 1975).

GENERAL AND MISCELLANEOUS

Civilian Defense

2921 (AD/A-002291) DAMAGE ASSESSMENT MODEL FOR AGRICULTURAL CROPS. Final Report, July 1973–September 1974. Ryan, J. W.; Garza, P. A.; Brown, S. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). Sep 1974. Contract DAHC20-73-C-0212. 106p. (SRI-EGU-2729-FR). NTIS $5.25.

The major features and program flow of a damage assessment model for ten agricultural crops are described. Crop vulnerability to radiation damage (both β and γ) is differentiated by growth stage, total dose received, and dose rate. The model was developed for joint use by the Defense Civil Preparedness Agency, the U. S. Department of Agriculture, and the Office of Preparedness. The model was programmed in Fortran and designed to be compatible with the ready damage assessment system of the mathematics and computation laboratory of the General Services Administration. (GRA)

Information Handling

2922 (AGC-2097) GLOSSARY AND DEFINITIONS. Space, Missile, and Nuclear Terminology. (Aerojet-General Corp., Azusa, Calif. (USA)). 25 Sep 1961. 40p. Dep. NTIS $5.00.

The glossary was prepared to meet the need for standardized communication, and to provide a common ground for clearly expressing terms used in missile and space technology. (JRD)

Law

2923 24. JAHRESBERICHT (1. APRIL 1972 BIS 31. MAERZ 1973) UEBER DIE TAETIGKEIT DES INSTITUTS FUER VOELKERRECHT DER UNIVERSITAET GOETTINGEN. (24th Annual Report (April 1, 1972 – March 31, 1973) on the Activities of the Institut fuer Voelkerrecht, Goettingen University). Goettingen, F. R. Germany; Inst. fuer Voelkerrecht (Nov 1973). 22p. (In German).

The Atomic Energy Law Department of the Institute has been mainly concerned with the hearings and discussions initiated by the Federal Government with a view to amending the present German atomic energy law and the radiation protection ordinance. Furthermore, normal work for the documentation of international rules and legal provisions in this field as well as of relevant treaties and literature has been continued. (GE)

Management

2924 (GSF-S-310) ANNUAL REPORT 1973. Godt, K. J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Jun 1974. 90p. (In German). INIS.

The main emphasis in research and development during the reported year was on: (1) analysis of the somatic radiation risk and studies on the determination of limiting values of radiation exposure on the basis of a risk concept; (2) experimental and theoretical investigations on the interaction and path structure of ionized particles in tissue-equivalent materials; (3) dosimetric and spectrometric analysis of X-ray, gamma and neutron fields when applied in research, medicine and technology; and (4) further development of analytic methods and their application in the investigation of the ecological behavior of special radionuclides and trace amounts of inactive, toxic elements, especially lead and cadmium. (GE)

2925 (INIS-mf-1662) PROGRESS REPORT, 1972. Nuclear Research Centre. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre). [nd]. 76p. INIS.

A summary is given of the personnel complement, accelerator operation, research program, publications, internal reports, and TRIUMF publications of the Nuclear Research Center. Extensive improvements were made on the van de Graaff accelerator and its attendant electronics. Research programs are being pursued on charged particle studies, gamma ray studies, pulsed beam measurements, nuclear astrophysics, and other topics in theoretical physics. (INIS)

2926 (INIS-mf-1663) ANNUAL REPORT, 1972. Eldorado Nuclear Limited. (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)). 6 Mar 1973. 13p. INIS.

For the fourth consecutive year Eldorado Nuclear Ltd. recorded a loss reflecting the slump in uranium sales to utilities worldwide. Capital expenditures were divided between expanding the Beaverlodge mine and maintaining and expanding the Port Hope refinery, with special emphasis on effluent treatment and monitoring. Mining operations continued at curtailed capacities and mill recoveries were up. Exploration activities were modest due to lack of funds. At Port Hope, UO_2 production was at record levels as a result of Canadian utility requirements. (INIS)

2927 (INIS-mf-1665) ATOMIC ENERGY CONTROL BOARD: ANNUAL REPORT, 1973-74. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1974. 80p. (In English and French). INIS.

The activities, organization, and legal functions of the Board are described for the year ending 31 March 1974. The Board is charged with the licencing, inspection, and other regulatory activities concerning nuclear reactors, heavy water plants, particle accelerators, radioactive waste management, prescribed substances, radioisotopes, transportation and security of nuclear materials. Grants in aid of atomic energy research are described. (INIS)

2928 (INIS-mf-1738) INSTITUTE OF THEORETICAL PHYSICS ANNUAL REPORT 1973. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Teoretisk Fysik; Goeteborg Univ. (Sweden). Institutionen foer Teoretisk Fysik). 1974. 59p. INIS.

The Institute of Theoretical Physics is a joint institute for research and education in theoretical physics serving Chalmers University of Technology and the University of Goteborg. The budget for 1973 is summarized and indication given of the number of persons employed at the institute. Brief details are given of research projects in the fields of elementary particle physics, condensed matter physics and mathematical physics. Graduate and undergraduate teaching and the degrees awarded are discussed. Details of visits to other institutions and conferences are given together with lists of published papers and institute reports. (INIS)

2929 (LA-5924-MS) LOS ALAMOS BUILDING COST INDEX. Bennett, G. A.; Lemon, G. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

A building cost index for Los Alamos Scientific Laboratory new construction was developed. The Los Alamos index curve was exponential during the last few years. Labor and material/equipment cost histories were gathered for the previous five years and form the basis of the index. The Los Alamos Building Cost Index is of the input type. It includes 12 field labor crafts and 17 material/equipment categories. Care was taken in compiling information to reflect the relative importance of labor and material/equipment costs as components of total project cost. A comparison with other input and output indexes was made to isolate trends taking place in New Mexico. (auth)

2930 (SAAS-166) BOARD OF NUCLEAR SAFETY AND RADIATION PROTECTION OF THE GERMAN DEMOCRATIC REPUBLIC. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Sep 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The tasks of the Board of Nuclear Safety and Radiation Protection (SAAS) of the German Democratic Republic are briefly described considering legislation, licensing, training, research, surveillance of occupationally exposed personnel (medical supervision, personnel monitoring, inspection of working areas), plant and process safety (nuclear plants, radioactive wastes, transport), environmental monitoring and nuclear safeguards. The SAAS is responsible for the coordination of all activities which may be related to radiation protection. An outline of nuclear science and technology activities in the GDR is given. (auth)

2931 DIVERSIFICATION OF NUCLEAR RESEARCH CENTERS. Harig, H. D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Umsch. Wiss. Tech.; 74: No. 10, 309-311 (May 1974). (In German).

When in the sixties nuclear power became commercial, people believed that nuclear centers had fulfilled their tasks to a great extent. The highly qualified centers got into a crisis. Governments tried to give new objectives to the nuclear laboratories which were to use their resources and experiences for technological advance and innovation in non-nuclear industrial fields. More than in other countries, in Germany, universities had been a pattern for the foundation of nuclear centers. Hence social and structural problems arose at the same time when discussions on new programs began in German research establishments. Consequently, the diversification and orientation towards non-nuclear and more commercialized programs had become a question also of management and organization of the research centers in order

to enable the laboratories to set priorities for the most appropriate targets among the huge number of problems which society has to solve with only a limited capacity of research. (GE)

2932 AEC AUTHORIZING LEGISLATION, FISCAL YEAR 1975. Part 3. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on Physical Research and Regulatory, February 28, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 456p. GPO $3.95

This volume contains testimony on the proposed budget for the physical research program presented at public hearings of the Joint Committee on Atomic Energy on the proposed AEC authorizing legislation for fiscal year 1975. Atomic Energy Commission witnesses were Commissioner William O. Doub; Director of Regulation L. Manning Muntzing; Dr. Wolfgang K. H. Panofsky, Director, SLAC; Dr. John M. Teem, assistant general manager for physical Research and Laboratory Coordination; and Dr. Robert R. Wilson, Director, NAL. Other witnesses included B. James Porter, Donald C. Gilbert, Hon. Sterling Cole, and Wyatt M. Rogers, Jr. Prepared statements, questions and answers, a letter from AEC Chairman Ray, and the report of the ad hoc panel on heavy-ion facilities are included. (RWR)

Mathematics and Computers

Refer also to abstract 767.

2933 (WANL-TNR-164) NOTES ON EFFICIENT FORTRAN PROGRAMMING. Saalbach, C. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 106p. Dep. NTIS $8.50.

The advantages of the COMMON statement in using the same variables in different parts of a program are illustrated. Subroutines with arguments must wait till execution time for initiation and extra instructions are required. However, some of the problems can be avoided by the proper use of arguments in the SUBROUTINE statement. They must be non-subscripted fixed or floating point variables. They may appear in a DIMENSION statement. Arguments in the CALL must always agree in mode (fixed or floating) with the corresponding arguments in the SUBROUTINE statement. For non-dimensioned arguments (input or output), the corresponding argument in the CALL can be any non-dimensioned variable or subscripted variable of the same mode. For dimensioned arguments (input or output) in the SUBROUTINE statement, the corresponding arguments in the CALL can be any dimensioned variable, subscripted or non-subscripted, of the same mode. Examples are given to demonstrate the improvements in efficiency obtained by these approaches and some other details given. (LTN)

Chemistry

2934 (AED-CONF-74-085-009) RELAXATION TIME MEASUREMENTS IN BENZENE AFTER ELECTRON BEAM EXCITATION. Hartfuss, H. J. (Giessen Univ. (F.R. Germany). 1. Physikalisches Inst.). 1974. 8p. (In German). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V., its expert committees on: Atomic physics, pulse physics, molecular physics, plasma physics; Stuttgart, F.R. Germany (4 Mar 1974).

7 figs.; 3 tabs.; 7 refs.

Fluorescence investigations on organic vapors with electron beam excitation are described. Of particular interest is the radiationless intercombination transition in benzene, which transfers excited S_1 states into iso-energetic vibrational states of the next lower lying triplet state T_1. (GE)

2935 (CRN-CNPA-74-18) APPLICATION OF THE MOESSBAUER SPECTROSCOPY OF ANTIMONY-121 TO SOME PROBLEMS OF STRUCTURAL CHEMISTRY. Devort, J. P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1974. 139p. (In French). INIS.

The 37.15-keV resonance of antimony-121 was applied to some problems of structural chemistry. First some generalities and the peculiarities of ^{121}Sb spectroscopy are recalled. The experimental techniques are described (transducer, electronics, liquid helium cryostat) and the methods for computer analyzing the experimental data are discussed (least squares fitting taking into account the absorber thickness). Experimental data of some selected antimony III and V compounds are included. The correlations between the hyperfine interaction parameters and the nature of ligands as well as the antimony hybridization are discussed. From the measurement of the hyperfine interaction parameters of the ^{121}Sb and ^{127}I nuclei in SbI_3, $3S_8$ is deduced an experimental value of the ^{121}Sb atomic quadrupole interaction, which is in good agreement with earlier theoretical estimates. (FR)

2936 (KFKI-74-85) LIQUID CRYSTAL CHEMISTRY. III. Cholesteric Mesophase. Pinter, K. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). [nd]. 26p. (In Hungarian). Dep. NTIS (US Sales Only) $4.50.

Basic structural properties of compounds showing cholesteric liquid crystalline behavior are reviewed and the role of structural effects on the mesomorph state and the practical use of such compounds are shortly outlined. (auth)

2937 (LA-tr-75-7) DYNAMIC INSTABILITIES IN HETEROGENEOUS GAS-SOLID REACTIONS. Fitzer, E. Translated from Chem.-Ing.-Tech.; 4: 331-339(1969). 27p. Dep. NTIS $4.50.

The simultaneous hot-wall pyrolysis of vaporized chlorides of silicon, boron, or titanium and methane to carbides with excess carbon leads to heterogeneous deposits with a microscopically recognizable lamellar structure. The stratification parallel to the substrate surface gives an insight into the oscillating course of pyrolysis with periods on the order of magnitude of seconds. The course of the reaction in the gas boundary film is compared with the dynamically unstable behavior of stationary chemical reactors. An analogous oscillation mechanism for pyrocarbon deposits from methane was found. (auth)

Life Sciences

2938 (ORO-3885-8) CELL RESPONSE TO NUCLEIC ACID PENETRATION. Progress Report, July 1, 1974–June 30, 1975. Stuy, J. H. (Florida State Univ., Tallahassee (USA). Dept. of Biological Science). 1975. Contract AT(40-1)-3885. 13p. Dep. NTIS $4.00.

The uptake of DNA is influenced by the quality of the DNA; foreign DNA appears to be adsorbed less rapidly and small circular DNA may not be adsorbed at all. Upon adsorption, all species of linear DNA molecules are partially degraded (outside the cell?), i.e., about two of every ten molecules are completely acid-solubilized. It is not clear why foreign DNA is adsorbed more slowly. The intracellular fate of adsorbed DNA depends on the source of donor DNA. Foreign DNA is only very slowly degraded despite the fact that cell extracts show high site-specific endonuclease activity on these DNAs. Homologous and heterologous DNA is broken down; about half of the molecules are completely degraded but again, no site-specific endonucleases appear to be involved. Perhaps the degradation requires a membrane site and foreign DNA does not recognize such sites. Homologous DNA is partially integrated. In the case of phage HP1 DNA this integration appears to involve whole or nearly whole molecules (single strands?). I believe that this may be true for bacterial DNA as well. Low efficiency mismatch markers (gene conversion) are thus repaired out in a later stage. A small fraction of the absorbed DNA is never integrated. (auth)

2939 (RLO-2225-5-23) THEORETICAL STUDIES OF GENE SUBSTITUTION, GEOGRAPHIC VARIATION, AND SPECIATION. Annual Progress Report, November 1, 1973–October 31, 1974. Felsentein, J. (Washington Univ., Seattle (USA). Dept. of Genetics). 1974. Contract AT(45-1)-2225. 9p. Dep. NTIS $4.00.

Materials

2940 (JINR-P4-8575) ASYMPTOTICALLY EXACT METHODS IN THE BAND THEORY OF MAGNETISM. Moshchinskii, B. V.; Fedyanin, V. K. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The model Hamiltonian, that takes into account the Coulomb interaction effects side by side with the exchange interaction, was considered by the Bogolubov (Jr.) method. On the basis of the approximating Hamiltonian, thermodynamically equivalent to the initial one, there was obtained and discussed the system of nonlinear integral equations for the ordering parameters. (tr-auth)

2941 (MHSMP-72-12) DISPOSAL OF WASTE OR EXCESS HIGH EXPLOSIVES. Progress Report, September–December 1971. Wichmann, J.; Honea, F. I. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1971. 52p. Dep. NTIS $5.75.

The problem of disposal of deteriorated or unused explosives and explosive-contaminated material in accordance with government environmental guidelines is studied. The objectives of this effort are: (1) to determine the magnitude of the problem associated with meeting the new regulations at the AEC facilities; (2) to determine methods of disposal; and (3) to select the best methods and develop pilot-scale processes. During the preliminary six-months review of disposal methods, incineration emerged as a sure and attainable method for disposal of HE (high explosives) and HE-contaminated materials in the near

future. Consequently, an effort has been started towards development of a pilot-plane incinerator. However, from the long-range viewpoint, recycle or conversion methods are more desirable for conservation of materials and curtailment of pollutants. Consequently, much effort is still being devoted to consideration of collection and reuse of explosive scraps, chemical reconstitutions, and biochemical processes. New methods discovered during the literature perusal and contacts with other agencies are reviewed for potential disposal of HE. Effort in waste explosive reclamation has been concentrated on the water-solvent slurry reworking and solvent extractions of plastic bonded HE. Work was shifted from separation and treatment of mixtures of explosives to recovery and reconstitution of individual explosives. (PMA)

2942 (MHSMP-72-30) DISPOSAL OF WASTE OR EXCESS HIGH EXPLOSIVES. Progress Report, January–March 1972. Honea, F. I.; Wichmann, J.; Bullerdiek, W. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1972. 54p. Dep. NTIS $5.75.

An investigation of disposal and reclamation methods for waste and excess explosives with respect to air pollution guidelines is continued. Laboratory experiments for reclamation of waste explosives concentrated on the use of organic solvents and nitric acid. A study of the biodegradation of various explosives was begun, and initial results show that: (1) all of the materials are biodegradable; (2) the degradation rates are very slow; and (3) further analytical work must be done to permit calculations of rates. Measurements were made of combustion products in expanding chamber explosive burning experiments, and recovery characteristics are discussed for nitrogen oxides (NO and NO_2), carbon monoxide, and hydrofluoric acid vapor. The design of a pilot-plant incinerator for disposal of HE (high explosives) and HE-contaminated materials was begun. Also, a new "closed-pit" incinerator concept for small batches of HE was invented and is scheduled for evaluation tests. A feasibility study for a continuous-feed incinerator system for HE-contaminated and uncontaminated combustible materials was completed. (PMA)

Physics and Engineering

2943 (BMFT-FB-T-74-24) THE DEVELOPMENT OF AUTOMATICALLY CONTROLLED MACHINING PROCESSES OF OPTICAL PARTS WITH THE AID OF RADIANT ENERGY. Schleich, F.; Bach, H. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany)). Oct 1974. 85p. (In German). INIS.

17 figs.; 2 tabs.; 53 refs.

There is an interest in using electron and ion beams in the optical industry. Electron beam welding, ion beam removal of glass and the electrical control of such processes were examined. Glass can be welded with a special pulse technique. Basic physical laws with ion beam edging were studied. The optimum glass removal rates established for ion beams are not good enough for an economical utilization in production. The instrument developed is suitable as an ion edging device for microscopic purposes. A newly designed multi-zone target results in a layer thickness variation of better than ±1%. (auth)

2944 (CRN-CNPA-74-15) REALIZATION OF A MOESSBAUER SPECTROMETER FOR SURFACES AND THIN FILMS STUDY. Schunck, J. P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1974. 117p. (In French). INIS.

The subject concerns the application of Moessbauer spectroscopy to surface studies. The hyperfine interactions deduced from Moessbauer spectra allow the study of the oxidation state, the symmetry of electronic and ionic charges around the nuclei, and the magnetic interaction with the latter. When Moessbauer spectra are obtained with conversion or Auger electrons, only the nuclei near the surface are studied. It is therefore possible to know the chemical structure of the outermost layer of the sample. The maxima depth analyzed is 3500 A in the case of iron and 3 μ in the case of tin. The measurement can be done as a function of depth by analyzing in energy the electrons slowed down during their passage through matter. An instrument comprising a Moessbauer and a β spectrometer was built in order to study samples at different depths. Some practical applications are presented using the resonance of ^{57}Fe and ^{119}Sn. (FR)

2945 (CRN-CNPA-74-17) INVESTIGATION OF THE STRUCTURE OF SOME COMPOUNDS OF IRON AND COBALT BY MOESSBAUER SPECTROSCOPY. Jodin, P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires). 1974. 84p. (In French). INIS.

The Moessbauer effect on ^{57}Fe was used in order to study possible phase transitions in some iron and cobalt complexes. In the latter case, the cobalt lattice was doped with ^{57}Fe at a concentration of about 0.5%. The first type of compounds studied in the present work is the series of hexanitrites of transition metals. Their investigation did not show the existence of any phase transition, but complementary data on the structure of the anion $M(NO_2)_6^{4-}$ were collected. The compounds $FeCl_2$, py and $FeCl_2$, $\frac{2}{3}$ py were studied because it has been previously demonstrated that $FeCl_2$, 2 py exhibited a crystal phase transition at 235 K. The large temperature dependence of the quadrupole interaction in $FeCl_2$, py and $FeCl_2$, $\frac{2}{3}$ py is explained in terms of crystal field theory. The observation of phase transition is finally reported in $Co(BF_4)_2$, $6H_2O$ and $CoSiF_6$, $6H_2O$ doped with ^{57}Fe. These transitions occur respectively at 185 K and 270 K. (FR)

2946 (JINR-P4-8220) CORRELATIONS AND DISTRIBUTIONS OF THE NUMBER OF PARTICLES WITHIN PARTIAL VOLUMES. Ziesche, P.; Zagrebnov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

It is considered how the distribution and correlations of particles within partial volumes of many-particle systems follow from reduced distribution functions. All results are valid for both quantum and classical systems. (tr-auth)

2947 (MHSMP-75-11) ACOUSTIC EMISSION: A NEW MEASUREMENT CONCEPT. Carter, J. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Mar 1975. 19p. Dep. NTIS $4.00.

Acoustic emission analysis is sensitive to local transient instabilities. The acoustic emission phenomena originate in the form of burst pulses or continuous energy emission of acoustic energy emanating from the atomic structure of material while under load, deformation, stress, or during change in crystal structure. Schematic monitoring systems are shown for hydrostatic testing of pressure vessels and pipelines and for monitoring structural materials, weld quality, and fatigue tests. (MCW)

2948 (RT/CHI-(74)10) VOLTAMMETRY AT A STATIONARY PLANE ELECTRODE. Part I. Reversible and Irreversible Simple Processes. Casadio, S.; Magini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov 1974. 17p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

The Reinmuth–Nicholson method (reported in detail) was applied to solve the boundary value problems for reversible and irreversible simple processes for linear potential scan voltammetry at stationary plane electrode. (tr-auth)

2949 (SAND-74-0209) REMOTE MEASUREMENT OF METEOROLOGICAL PARAMETERS BY OPTICAL RADAR. Hargis, P. J. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 169p. Dep. NTIS $11.50.

Optical radar techniques for the remote measurement of meteorological parameters that are required for the calculation of projectile trajectories through the atmosphere are examined. The required parameters are atmospheric density, water vapor content, temperature, pressure, and wind velocity. The measurement techniques that are discussed include Rayleigh, Mie, and Raman scattering measurements; absorption and fluorescence measurements; and Doppler measurements. Calculations of the maximum range and accuracy which can be obtained with each measurement are presented. (MCW)

2950 (UH-235-P9-13) PHOTOELECTRIC EMISSION FROM THIN FILMS IN THE VACUUM ULTRAVIOLET REGION. Annual Progress Report, 1 March 1974-28 February 1975. Pong, W. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 1 Mar 1975. Contract AT(04-3)-235. 17p. Dep. NTIS $4.00.

Research is summarized on the further development of an understanding of the energy band structure of alkali halides and other materials. New photoelectron spectra of materials in the photon energy range 7 to 23 eV, and materials which show solid-phase changes at elevated temperature were studied. A list of publications is included. (JFP)

Appendix 1

SCOPE AND SECTION ARRANGEMENT OF NUCLEAR SCIENCE ABSTRACTS

Introduction

This publication defines the subject scope and arrangement of the literature in *Nuclear Science Abstracts (NSA)*. Broadly stated, the subject scope of *NSA* includes all of nuclear science and technology defined as follows:

> Nuclear science is the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, and nuclear radiation.
>
> Nuclear technology is the application of nuclear science to other sciences and engineering, and conversely, the application of other sciences and engineering to the problems of nuclear science.

Part 1 identifies the major fields of nuclear science and technology into which *NSA* is divided. Subdivisions are listed under each field. Each subdivision is followed by statements of specific subject interest. These statements have been prepared to show the exact range and limits of subject interest for selecting literature abstracted and indexed in *NSA*.

Part 2 identifies the extent of interest in the chemical elements.

An index to Part 1 begins on page 23.

NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. Selection is based on subject content; nothing is excluded solely on the basis of form, origin, or language. Some of the general practices followed in selecting literature for *NSA* are as follows:

1. Popular type articles are not included.
2. Textbooks below the graduate level are not included.
3. Theses below the doctoral level are not included.
4. Patents that have been filed in several countries are included only once.
5. Material existing only as abstracts or short summaries is not included except for papers summarized in the *Transactions of the American Nuclear Society*.
6. Material initially published in a language other than English may be included both when an item is published in the original language and when an item appears in an English language translation.
7. Related groups of engineering drawings and specifications are abstracted and indexed in *NSA* when they become publicly available.
8. As a general practice, material more than two years old is not included in *NSA*.

All journals scanned regularly are listed annually in Issue No. 1 of odd numbered volumes. New additions are listed in issue 1 of even numbered volumes.

Part 1

SCOPE AND ARRANGEMENT OF NSA
(Numbers in parenthesis are for retrieval purposes)

CHEMISTRY (40.000)

Analytical and Separations Chemistry (40.100)

[Analytical chemistry of isotopes, transactinides, actinides, lanthanides, Be, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, or any element or compound if the application is directly associated with nuclear technology. Analyses to determine reactor fuel burnup; burnup calculations are included under REACTOR TECHNOLOGY. Arrangement is according to analytical procedure. Information relative to analytical methods is included as indicated.]

Activation and Nuclear Reaction Procedures (40.110)

The subject in general or descriptions of the method.

Chemical and Spectral Procedures (40.120)

Radiometric and Radiochemical Procedures (40.130)

Nuclear radiometric or radiochemical procedure, including properties of radioisotopes as sources in x-ray analyses. Routine tracer studies are excluded.

Separation Procedures (40.140)

Separation procedures for transactinides, actinides, lanthanides, Be, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, and any material of interest in nuclear technology except the procedures covered elsewhere, e.g., under Activation Procedures, Reactor Fuel Reprocessing, and Radioactive Waste Treatment.

Inorganic, Organic, and Physical Chemistry (40.200)

Chemical and Physicochemical Properties (40.210)

Chemical and physicochemical properties of nonradioactive elements, compounds, or mixtures directly associated with nuclear technology. Also includes the preparation of radioprotective compounds.

Isotope Effects (40.220)

Isotope effects on nonnuclear chemical and physical properties. Isotope effects are excluded when used only as a tool in the analysis of reaction mechanisms or in structure studies.

Isotope Exchange and Isotope Separation (40.230)

Isotope exchange if the exchange is of primary concern or the exchange mechanism is used in isotope separation.

Chemical and physicochemical isotope separations are included here; but industrial scale processes such as gaseous diffusion and centrifugation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Radioisotope production is included under Radiochemistry and Nuclear Chemistry.

Feed Materials Processing (40.240)

Chemical processing of ores for recovery of uranium or thorium, including all extraction, conversion, or reduction steps. Also includes chemical engineering of plants for such processing, but site surveys and environmental impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

Radiation Chemistry (40.300)

[The radiations considered here include accelerated ions, gamma radiation, x radiation, bremsstrahlung, neutrons, protons, alpha particles, beta particles, deuterons, and other subatomic particles. Ultraviolet, infrared, and visible radiations are not included.]

Radiation effects on the chemical and physicochemical properties of any element, compound, or mixture. General papers on solvated electrons and hydroxyl radicals are also included. Radiation effects on the biological activity of biochemicals in vitro or in vivo and all information on radiation effects on biochemicals in living organisms are included under LIFE SCIENCES. Radiation effects on metallurgical or solid state properties are included under MATERIALS or PHYSICS (SOLID STATE).

Radiochemistry and Nuclear Chemistry (40.400)

Radiochemistry and nuclear chemistry are included without restrictions except for tracer applications and labeled compound preparation, which are included only if there is a contribution to the technology. Include those items that detail the technology, but exclude those in which no change in methodology is indicated.

Hot-Atom Chemistry (40.410)

Any aspect, including recoil production and reactions.

Properties of Radioactive Materials (40.420)

Chemical and physicochemical properties of radioactive elements or materials, including the stability of labeled compounds and chemical decontamination of surfaces or work areas. Decontamination of reactor vessels following accidents is included under REACTOR TECHNOLOGY.

Radioactive Waste Treatment (40.430)

Radioactive waste processing for concentration, decontamination, or fission product recovery.

Waste disposal monitoring is included under ENVIRONMENTAL AND EARTH SCIENCES; waste disposal is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Radioisotope Production (40.440)

Radioisotope production processes involving chemical separations. Development and uses of radioisotope radiation sources are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Reactor Fuel Reprocessing (40.450)

Reactor fuel processing, including analytical control, chemical separations, solvent studies, and plant and process design, performance, and operation. Environmental monitoring and impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

CONTROLLED THERMONUCLEAR RESEARCH (70.000)

Plasma and thermonuclear physics, except solid-state plasma, arranged as follows:

Confinement and Heating (70.100)

Diagnostics (70.200)

Kinetics (General) (70.300)

Kinetics (Experimental) (70.400)

Kinetics (Theoretical) (70.500)

Production (70.600)

Stability (70.700)

Thermonuclear Engineering and Equipment (70.800)

Wave Phenomena (70.900)

ENGINEERING (42.000)

Energy Conversion (42.100)

Equipment and methods for the direct conversion of nuclear energy from radioisotopes or fission products into electric energy, e.g., beta-voltaic cells, thermoelectric generators, thermionic converters, cardiac pacemakers, etc. Information on the use of reactors as heat sources for electric energy generation is categorized under REACTOR TECHNOLOGY AND REGULATION. Information on the fabrication, performance testing, and use of radioisotope heat sources is categorized under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Facilities and Equipment (42.200)

Design, construction, operation, and applied mechanics studies (stress, strain, motion, vibration, elasticity, deformation, etc.) of nuclear facilities and equipment including components of such facilities and equipment, e.g., irradiation plants, pilot plants, laboratories, etc. Only those facilities and equipment are included here for which a more appropriate category has not been provided. In general, information on facilities and equipment is included under categories more closely related to the purpose of the facility or equipment, e.g., CHEMISTRY, PARTICLE ACCELERATORS, REACTOR TECHNOLOGY AND REGULATION. Remote handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Lasers (42.210)

Laser research and development information (not applications). Applications of lasers in isotope separation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY and CHEMISTRY. Applications of lasers in fusion plasma production and heating are included under CONTROLLED THERMONUCLEAR RESEARCH.

Cryogenic and Superconducting Equipment and Devices (42.220)

Design, fabrication, performance, and testing of superconducting equipment and devices, e.g., superconducting cables, magnets, generators, etc., or equipment and devices using superconductors or superconducting junctions as a component, e.g., superconducting quantum interference devices (SQUIDS), Josephson junctions, etc. Cryogenic equipment and devices are also included when such equipment and devices are used in applications of superconductivity. Applications of superconductivity in accelerators and fusion reactors are included under PARTICLE ACCELERATORS and CONTROLLED THERMONUCLEAR RESEARCH, respectively. Information on the theory of superfluidity and superconductivity is included under PHYSICS (LOW-TEMPERATURE). Information on superconducting materials is included under MATERIALS.

Heat Transfer and Fluid Flow (42.300)

Heat transfer and fluid flow if nucleate boiling, boiling burnout, critical heat flux, two-phase flow, flow in rod bundles, or liquid metals are considered. Heat transfer or fluid flow applied in nuclear technology is included under sections for the application.

Materials Testing (42.400)

Destructive or nondestructive materials testing if a direct application to nuclear technology is indicated and if categorization on the basis of application would be less appropriate. In general, information on component testing is included under categories more closely related to the component, e.g., information on reactor fuel element testing is included under REACTOR TECHNOLOGY.

The use of radioisotopes and radiation sources in radiographic or radiometric testing is included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Nuclear Explosions (42.500)

Detection of nuclear explosions and civil uses of nuclear explosions, including simulations using non-nuclear explosives.

Protective Structures and Equipment (42.600)

Structures and equipment designed primarily for equipment and personnel protection, e.g., blast and fallout shelters, shielding (except for accelerator and reactor shielding), clean rooms, air filtration systems, fire protection systems, masks, and special clothing. The fabrication of bulk shielding is

included under MATERIALS, shielding calculations are included under PHYSICS (RADIATION AND SHIELDING), and remote-handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Safety Engineering (42.700)

Safety at nuclear facilities if no more appropriate category is provided. In general, safety engineering information is included under categories for specific activities or facilities, e.g., Nuclear Explosions or REACTOR TECHNOLOGY.

Vacuum Engineering (42.800)

Ultrahigh (10^{-9} torr or greater) vacuum systems and equipment if no nuclear application is indicated. Applied vacuum engineering is included under categories for the applications, e.g., PARTICLE ACCELERATORS.

ENVIRONMENTAL AND EARTH SCIENCES (44.000)

Minerals and Ores (44.100)

Identification, properties, prospecting, mining, and estimated reserves of thorium and uranium minerals and ores (including equipment). Chemical processing of ores is included under CHEMISTRY.

Radioactive Effluents (44.200)

Concentration or levels of radioactive materials discharged to the natural environment (atmosphere, soil, and waters) under accident or normal operating conditions at nuclear facilities.

Radioactivity Monitoring and Transport (44.300)

Monitoring and/or transport and distribution of radioactive materials (including natural radioactivity) in or through the atmosphere, soil, or waters of the earth. Also includes monitoring and radiation hazards presented by radioactive materials in ecosystems or food cycles. Instrumentation for monitoring radioactivity is included under INSTRUMENTATION.

Radiometric Techniques (44.400)

Use of radioisotopes or radiation sources in investigations of the environment or the earth, e.g., soil and water movement, isotopic methods of geochronology, etc., if the technique is of primary concern or is presented as an advancement of the technology. Instrument design is included under INSTRUMENTATION.

Site Surveys (44.500)

Evaluation and selection of sites for nuclear installations such as fuel fabrication plants, radiochemical processing plants, and nuclear explosions. Seismological and background radiation surveys are included. Ecological studies of sites for nuclear facilities and sites for radiological research are also included. Nuclear power plant siting is included under REACTOR TECHNOLOGY.

Thermal Effluents (44.600)

Characteristics, quantities, and effects of thermal discharges to the atmosphere, soil, or waters of the earth from chemical plants, both fossil- and nuclear-fueled power plants, or any other facility with thermal discharges of the same order of magnitude.

Chemical Effluents (44.700)

Characteristics, quantities and effects of nonradioactive chemical discharges to the atmosphere, soil, or waters of the earth from nuclear facilities such as reactors, gaseous diffusion plants, fuel reprocessing plants, etc. Chemical effluents considered in comparative studies of energy production methods are also included.

INSTRUMENTATION (46.000)

Radiation Detection Instruments (46.100)

Arrangement is as follows:

- General Detectors and Monitors
- Radiation Dosimeters
- Nuclear Spectroscopic Instrumentation (Includes Moessbauer spectrometers)
- High-Energy Physics Instrumentation

Radiometric Instruments (46.200)

Any instrument employing a radiation source and/or radiation detector in its operation.

Radiation Effects on Instrument Components, Instruments, or Electronic Systems (46.300)

Miscellaneous Instruments (46.400)

Limited to instruments, instrument components, or instrumentation systems for application in nuclear technology.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY (47.000)

Isotope Separation (Industrial) (47.100)

Industrial processes for heavy water production, uranium enrichment, or other isotope separation.

Isotopic Power Sources (47.200)

Use of radioisotopes (fission products) as sources of electric, propulsive, or thermal energy.

Radiation Sources (47.300)

Design or fabrication of radiation sources, including neutron sources, but not accelerators or reactors. Use of radiation sources in industrial processes such as food processing, sterilization of medical supplies, polymer production, etc. Basic radiation effects are included under CHEMISTRY or LIFE SCIENCES, but information on radiation effects that influence product acceptability or marketability, such as color or taste, is included here.

LIFE SCIENCES (48.000)

[For this section the term RADIATION is defined as nuclear particles, accelerated electrons and ions, and γ and x radiations. Information on uv effects is included *only* if microorganisms, cells, or biochemicals are the subjects of study. Laser radiation, magnetic fields, microwaves, and sunlight are excluded. The concept of RADIATION EFFECTS includes the effect itself, radiomimetic effects, and any information relating to the effect, e.g., information on assessment, prevention, alteration, transmission, reversal, recovery, etc., and information on the determination or influence of experimental variables such as dose, dose rate, LET, etc. This includes modification of radiation effects by radioprotective or effect-enhancing substances and studies on these substances to establish their independent effects. Theoretical aspects of dose determination or measurement in tissue equivalent materials or phantoms are included under PHYSICS (RADIATION AND SHIELDING).]

Radiation Effects on Biochemicals (48.100)

Effects on biochemicals in living organisms and on their biological activity; information on other effects on biochemicals outside living organisms is included under CHEMISTRY. Also includes the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Cells (48.200)

Effects of radiation from external or internal sources on cells in vitro, including cells in cultures; effects on in vivo cells are included in other LIFE SCIENCES categories for entire organisms. Also includes information on the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Microorganisms (48.300)

Effects on microorganisms, including bacteria, protozoa, unicellular algae, fungi, and yeasts. Uses of radiation in industrial processes for the radiopreservation of food, radiosterilization of medical supplies, radiation preparation of vaccines, etc., are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless effects on specific organisms are considered.

Radiation Effects on Plants (48.400)

Effects on plants (including multicellular algae and in vivo studies on plant cells), of external-source radiations including the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Industrial processes for radiopreservation or disinfestation of foods is under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Animals (48.500)

Man (48.510)

Effects of external-source or implanted-source radiations on man or on human tissues or cells in vivo. Therapeutic irradiation is included *only* if there is significant information on the effects on normal tissues, if evaluations are made for new radiation sources, e.g., pion beams, or if a contribution is made to the technology. Include those items that detail the technology, but exclude those in which no change in methodology is indicated.

Vertebrates (48.520)

Effects of external-source or implanted-source radiations on vertebrates or on vertebrate tissues or cells in vivo, including the preparation of animals for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Invertebrates (48.530)

Effects on invertebrates or on invertebrate tissues or cells in vivo, including the preparation of the organism for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Industrial scale processes for pest control and crop disinfestation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless there is significant information on the effects of radiation on specific organisms.

Radionuclide Effects (Internal Source) (48.600)

[Absorbed or incorporated radioactive materials, not implanted sources, in any in vivo studies.] Internal source evaluation and effects, including experimental procedures, but not the preparation of labeled compounds for administration.

Nuclide Kinetics and Toxicology (48.700)

Kinetics and toxicology of deuterium and radionuclides in or on living organisms. Also includes contamination and decontamination, both internal and external, of living organisms. Levels and movement of radionuclides through man's environment are included under ENVIRONMENTAL AND EARTH SCIENCES.

New Tracer Techniques (48.800)

Use of isotope tracers in LIFE SCIENCES research, e.g., animal husbandry, disease and pest control, ecology, medicine, if a contribution is made to the evaluation and technology of tracer usage. Include those items that detail the technology, but exclude those in which no change in methodology or application is indicated. Also includes extensive bibliographies or reviews.

MATERIALS (50.000)

Corrosion, erosion, surface phenomena, fabrication, phase studies, and properties (including physical, mechanical, electrical, and solid-state) are included with the limitations indicated in the arrangement below.

Radiation damage in or radiation effects on any material are included with the following exceptions:

Radiation effects on biological materials are included under LIFE SCIENCES.

Radiation effects on chemical or physicochemical properties are included under CHEMISTRY.

Ceramics and Cermets (50.100)

Coverage includes the borides, carbides, hydrides, nitrides, and oxides of those elements in Part 2 in which a metallurgy interest is indicated. Any studies of other ceramic or cermet materials supported by a nuclear organization or agency and studies of such materials at cryogenic temperatures are also covered.

Metals and Alloys (50.200)

Coverage includes those elements in Part 2 in which a metallurgy interest is indicated. Also covered are any metals or alloys studied at cryogenic temperatures and superconducting metals. Any other metals studies, such as steels, supported by a nuclear organization or agency are covered.

Other Materials (50.300)

Largely limited to materials applied or specifically for application in nuclear technology, e.g., carbon, graphite, concretes, plastics; but also includes any nonmetallic superconducting material or material, such as insulators, applied at cryogenic temperatures.

NUCLEAR MATERIALS AND WASTE MANAGEMENT (52.000)

Equipment, methods, standards, and systems, for safeguarding and management of materials of nuclear interest, e.g., fissionable materials, radioactive materials, radioactive wastes, or materials of special interest such as heavy water. The arrangement is as follows:

Accountability and Safeguards (52.100)

Research and development on equipment, methods, and systems to guard against the diversion of nuclear materials from uses permitted by law or treaty.

Disposal and Storage (52.200)

Studies, including economic, related to methods for the management, disposal, or storage of radioactive wastes, e.g., land burial, sea disposal, tank storage, or salt mine storage. Geological, hydrological, and seismological studies related to waste disposal are included. Monitoring, transport, and distribution of radioactive materials in the atmosphere, soil, and waters of the Earth are included under ENVIRONMENTAL AND EARTH SCIENCES.

Handling Equipment and Procedures (52.300)

Design, construction, and operation of equipment and facilities for handling radioactive materials, e.g., remote-handling equipment, glove boxes, and hot cells. Non-reactor criticality studies are included.

Transportation (52.400)

Regulatory and administrative aspects of radioactive materials shipping. Design, development, evaluation, and testing of radioactive materials shipping containers.

Radioactive waste processing is included under CHEMISTRY.

PARTICLE ACCELERATORS (54.000)

Particle, ion, atom, or molecule accelerators. The arrangement is as follows:

Design, Development, and Operation (54.100)

Auxiliaries and Components (54.200)

Ion Sources and Injection and Extraction Systems (54.300)

Ion Optics and Field Calculations (54.400)

Storage Rings (54.500)

Experimental Facilities (Includes Radiation Targets) (54.600)

PHYSICS (ASTROPHYSICS AND COSMOLOGY) (56.000)

Cosmic Radiation (56.100)

Cosmic radiation, including exposure ages and induced radioactivity of extraterrestrial material, e.g., meteorites and lunar material. Cosmic-ray interactions with the atmosphere and with the geomagnetic field are included under PHYSICS (ATMOSPHERIC).

Stars (56.200)

Composition, evolution, physical conditions, and nucleogenesis of stars; including neutron stars, black holes, and other starlike objects. Celestial mechanics and routine astronomical observations, e.g., sky surveys, are excluded.

Quasi-Stellar, Radio, and X-Ray Sources (56.300)

Theory, detailed studies, and location of such objects.

Solar Phenomena (56.400)

Sunspots and solar prominences, disturbances, wind, flares, radio bursts, magnetic fields, structure, and spectra. Solar wind interactions with the atmosphere or geomagnetic field are included under PHYSICS (ATMOSPHERIC).

Galaxies (56.500)

Formation, structure, and evolution of galaxies, characteristics of interstellar medium, and identification of molecular species in space.

Cosmology (56.600)

Structure and evolution of the Universe, gravitational collapse and detection of gravitational waves, and tests of general relativity. Gravitational wave detectors are included under INSTRUMENTATION. General relativity theory and field theories of gravitation are included under PHYSICS (HIGH-ENERGY).

Planetary Phenomena (56.700)

Interplanetary magnetic fields, radio emissions from planets, natural radioactivity of extraterrestrial materials,

formation and evolution of planetary systems (including the solar system), and radiation belts. Van Allen belts are included under PHYSICS (ATMOSPHERIC).

PHYSICS (ATMOSPHERIC) (58.000)

Auroral and Ionospheric Phenomena (58.100)

Associated particle kinetics only.

Effects of Nuclear Detonations (58.200)

Atmospheric effects only.

Magnetospheric Phenomena (58.300)

PHYSICS (ATOMIC AND MOLECULAR) (60.000)

Beams and Their Reactions (60.100)

Methods of production and techniques of using atomic, electron, ion, and molecular beams.

Electron and ion sources not developed for specific applications.

Reactions of beams with materials in bulk (e.g., scattering by surfaces, secondary emission, sputtering yields, etc.)

Atomic and Molecular Properties (60.200)

Atomic properties (experimental and theoretical studies) of helium, hydrogen (also deuterium and tritium), the lanthanides, scandium, technetium, yttrium, and elements having $Z \geq 84$.

Molecular properties of deuterium, helium (He_2, He_2, etc.), helium hydrides, hydrogen (H_2, H_2^+, H_3^+, etc.), tritium, and compounds of technetium and of elements having $Z \geq 84$.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules (60.300)

Properties of positronium, muonium, and muonic and mesic (π, K, etc.) atoms and molecules. Exotic atoms (involving antiprotons, hyperons, etc.) are included under PHYSICS (HIGH-ENERGY).

Basic mechanisms of positron annihilation, but not studies using positron annihilation as a tool.

Collision Phenomena (60.400)

Experimental and theoretical studies of elastic scattering, charge exchange (electron capture, electron loss, and electron attachment or detachment), excitation (deexcitation, excitation transfer), ionization, or dissociation in collisions of the following type: electron–ion, electron–atom, electron–molecule, ion–ion, ion–atom, ion–molecule, atom–atom, and atom–molecule.

Rearrangement collisions ($A + BC \rightarrow AB + C$), chemical exchange, and collisions in confined gases when no external beam is involved are excluded.

Atomic Theory (60.500)

Theory of atomic structure and properties when generally applicable. For theoretical studies of specific elements, see first statement under Atomic and Molecular Properties.

PHYSICS (ELECTROFLUID AND MAGNETOFLUID) (62.000)

Electrofluid and magnetofluid mechanics only.

PHYSICS (HIGH-ENERGY) (64.000)

Particle Interactions and Properties (Experimental) (64.100)

Experimental studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

Particle Interactions and Properties (Theoretical) (64.200)

Theoretical studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

Particle Invariance Principles and Symmetries (64.300)

Space-time symmetries and internal symmetries of particles and the applications of these symmetries to the electromagnetic, weak, and strong interactions.

Scattering Theory (64.500)

General scattering theory only; the application of scattering theory to specific interactions or types of particles is included under sections according to type of interaction.

NOTE: Category 64.400 (Field Theories) is discontinued. This subject area is now included in 76.000 PHYSICS (THEORETICAL).

PHYSICS (LOW-TEMPERATURE) (66.000)

Superfluidity (66.100)

Theory of superfluidity and studies on liquid helium as a superfluid.

Superconductivity (66.200)

Theory of superconductivity and superconducting phenomena.

Properties of specific superconducting materials are included under MATERIALS. Cryogenic equipment and superconducting magnets and devices are included under

ENGINEERING, except where categorization by application, e.g., PARTICLE ACCELERATORS, is more appropriate.

PHYSICS (NUCLEAR) (68.000)

The arrangement is as follows:

Neutron Interactions with Matter (68.100)

Neutron absorption, scattering, thermalization, transport, etc., in macroscopic systems, including solution of the neutron transport equation and theoretical neutron transport in matter in general geometric configurations.

Nuclear Properties and Reactions $A \leqslant 5$ (68.200)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $6 \leqslant A \leqslant 19$ (68.300)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $20 \leqslant A \leqslant 38$ (68.400)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $39 \leqslant A \leqslant 58$ (68.500)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $59 \leqslant A \leqslant 89$ (68.600)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $90 \leqslant A \leqslant 149$ (68.700)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $150 \leqslant A \leqslant 189$ (68.800)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $190 \leqslant A \leqslant 219$ (68.900)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $A \geqslant 220$ (69.100)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Theory (69.200)

Nuclear structure, nuclear matter, nuclear reactions and scattering, nuclear moments and spin, radioactive decay, spontaneous and induced fission, and nuclear models.

PHYSICS (PLASMA AND THERMONUCLEAR) (70.000)

This category has been renamed CONTROLLED THERMONUCLEAR RESEARCH. The Recon Number 70.000 was not changed.

PHYSICS (RADIATION AND SHIELDING) (72.000)

Radiation Physics (72.100)

Basic physical characteristics of radiation or of radiation passage through or scattering from materials not generally defined as shielding. This includes experimental or theoretical studies of range-energy relations, energy loss mechanisms, and absorption mechanisms, and calculations of dose distribution in tissue equivalent materials or phantoms. Dose determinations in biological materials is included under LIFE SCIENCES. Neutron transport in macroscopic systems is included under PHYSICS (NUCLEAR).

Radiation Protection Standards (72.200)

Standards written for a specific circumstance are included under appropriate sections.

Radiation Source Calibration and Standardization (72.300)

Radiation source design and fabrication or radiation source preparation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY or CHEMISTRY.

Shielding Calculations and Experiments (72.400)

Neutron shielding and shield fabrication are included under PHYSICS (NUCLEAR) and MATERIALS. Shield design is

included under sections for the application, e.g., PARTICLE ACCELERATORS or REACTOR TECHNOLOGY.

PHYSICS (THEORETICAL) (76.000)

General (76.100)

Theoretical physics applicable to nuclear science (e.g., general quantum theory and mathematical physics) but not specifically applied. Theoretical physics when applied is arranged according to application.

Quantum Field Theories (76.200)

Basic studies of quantum field theories and quantum electrodynamics.

Gravitation and General Relativity (76.300)

Basic studies of gravitation theory and general relativity theory. Gravitational collapse, gravitational wave detection, and tests of general relativity are included under PHYSICS (ASTROPHYSICS AND COSMOLOGY).

REACTOR TECHNOLOGY AND REGULATION (77.000)

Design, development, construction, and operation of nuclear fission reactors.

Includes: fuel elements; cooling systems; pressure vessels; shielding: loading machines; steam and power conversion systems; components; auxiliary systems; accessories.

Excludes: control systems (use 79.400); economics (use 79.500); fuel cycle economics (use 79.600); fuels, general aspects (use 79.300); safety and siting (use 77.900); nuclear insurance (use 77.910).

Power Reactors, Non-Breeding, Light-Water Moderated, Boiling Water Cooled (77.100)

Includes: BWR-type.

Power Reactors, Non-Breeding, Light-Water Moderated, Non-Boiling Water Cooled (77.200)

Includes: PWR-type.

Power Reactors, Non-Breeding, Graphite Moderated (77.300)

Includes: GCR, AGR, HTGR, Molten Salt types.

Power Reactors, Non-Breeding, Otherwise Moderated or Unmoderated (77.400)

Includes: Heavy Water type.

Power Reactors, Breeding (77.500)

Includes: LMFBR, MSBR, GCFR.

Research, Test, Experimental, Zero-Power, and Training Reactors and Subcritical Assemblies (77.600)

Plutonium Production, Isotope Production, Chemonuclear, Materials Testing, and Material Processing Reactors (77.700)

Space, Mobile, Propulsion, Transportable, and Package Reactors (77.800)

Nuclear Ships Licensing and Regulation (77.810)

Safe-navigation regulations.

Reactor Safety and Environmental Aspects (77.900)

Reactor accident analysis, safety system performance (e.g., ECCS), environmental consequences of reactor construction and operation, including nonradioactive aspects, in-reactor facility waste processing and radiation protection.

Reactor Accident Liability (77.910)

Legal aspects of nuclear damage and risk, insurance, and financial security.

Reactor Theory and Calculation (79.100)

Reactor physics calculations and in-pile measurements (in reactors of any type).

Includes: criticality; dynamics; kinetics; lattice cell parameters; neutronics; physics; thermohydraulics.

Reactor Components and Accessories (79.200)

Design, construction, assembly, and performance—where no reactor type is specified.

Includes: buildings; coolants; cooling systems; loading machines; pressure vessels; shielding; structures.

Reactor Fuels (79.300)

Design, assembly, and performance of fuel elements and assemblies, fuel cycles, fuel handling procedures, and fuel requirements—where no reactor type is specified.

Excludes: production and fabrication of fuel element component materials; burnup in specific reactors types (use 77.100–77.800); fuel cycle economics (use 79.600); loading machines (use 79.200).

Reactor Control Systems (79.400)

Systems for the control and surveillance of reactors of any type.

Includes: control elements and incorporated instruments; control element drive units; control by computers; data processing and display systems; systems for alarm and automatic shutdown; automatic initiation of protective systems or actions.

Excludes: instruments of potential use in control systems; safety and protective systems (e.g., ECCS).

Nuclear Power Plant Economics (79.500)

General studies of power plant construction and operation. Excludes: fuel cycle economics (use 79.600).

Reactor Fuel Cycle Economics (79.600)

Fuel resources and requirements and overall fuel cycle costs.

Reactor Licensing and Regulation (79.700)

All reactor Docket material (must have secondary category to type, e.g., 77.100, 77.200, and any other appropriate category), general licensing procedures and regulations.

GENERAL (80.000)

Civilian Defense (80.100)

Administrative and planning aspects only.

Energy Utilization and Economics (80.200)

Economic and feasibility studies of nonnuclear energy source development and utilization.

Note: only AEC-sponsored reports that are not announced in the journal *Energy Abstracts for Policy Analysis (EAPA)* are included.

Information Handling (80.300)

Manual or computer-based systems for data or information acquisition, processing, transmission and retrieval.

Law (80.400)

Legislative action and activities of agencies, committees, or organizations.

Management (80.500)

Organization, administration, financing, and general description of nuclear institutes and programs, e.g., directories, reference books, manuals, lists of publications, general bibliographies, training programs, etc.

Mathematics and Computers (80.600)

Mathematical methods and models and computer codes and programs for solving problems not related to nuclear science.

Miscellaneous (80.700)

Publicly available administrative and research and development reports from the United States Atomic Energy Commission and the national nuclear energy organizations of the United Kingdom, Canada, Sweden, Denmark, Japan, Australia, France, West Germany, and Norway which are outside the subject scope of other categories.

Chemistry (80.710)

Life Sciences (80.720)

Materials (80.730)

Physics and Engineering (80.740)

Part 2

EXTENT OF INTEREST IN THE ELEMENTS

ACTINIUM

All scientific and technical aspects

ALUMINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

AMERICIUM

All scientific and technical aspects

ANTIMONY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARGON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARSENIC

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ASTATINE

All scientific and technical aspects

BARIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BERKELIUM

All scientific and technical aspects

BERYLLIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

BISMUTH

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid bismuth
Nuclear properties and nuclear reactions

Radiation effects
Radiochemistry

BORON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

BROMINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CADMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

CALCIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CALIFORNIUM

All scientific and technical aspects

CARBON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Properties and fabrication of nuclear-grade graphite and graphite fuel materials
Radiation effects
Radiochemistry

CERIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

CESIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CHLORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CHROMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COBALT

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COPPER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CURIUM

All scientific and technical aspects

DYSPROSIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application) compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EINSTEINIUM

All scientific and technical aspects

ERBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EUROPIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

FERMIUM

All scientific and technical aspects

FLUORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

FRANCIUM

All scientific and technical aspects

GADOLINIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

GALLIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GERMANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GOLD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

HAFNIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HELIUM

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Superfluidity

HOLMIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HYDROGEN

Applications of the element or its compounds and systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of deuterium and tritium
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

INDIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

IODINE

Analysis, determination, and separation
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRON

Applications of the element and its alloys or systems, including steel and stainless steel, in nuclear technology or the behavior of the element, its alloys, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

KRYPTON

Analysis, determination, and separation
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LANTHANUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

LAWRENCIUM (103)

All scientific and technical information

LEAD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LITHIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LUTETIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

MAGNESIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

MANGANESE

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

MENDELEVIUM

All scientific and technical aspects

MERCURY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

MOLYBDENUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

NEODYMIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys, compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

NEON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

NEPTUNIUM

All scientific and technical aspects

NICKEL

Applications of the element or its alloys, compounds, or systems, in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

NIOBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

NITROGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NOBELIUM

All scientific and technical aspects

OSMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

OXYGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PALLADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PHOSPHORUS

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLATINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLUTONIUM

All scientific and technical aspects

POLONIUM

All scientific and technical aspects

POTASSIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PRASEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

PROMETHIUM

All scientific and technical aspects

PROTACTINIUM

All scientific and technical aspects

RADIUM

All scientific and technical aspects

RADON

All scientific and technical aspects

RHENIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

RHODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

RUBIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

RUTHENIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SAMARIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

SCANDIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

SELENIUM

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its

compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILICON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILVER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid sodium in cooling systems
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

STRONTIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SULFUR

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TANTALUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

TECHNETIUM

All scientific and technical aspects

TELLURIUM

Analysis, determination, and separation
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TERBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual

or simulated nuclear application), compounds, or systems, excluding mineralogy
Radiation effects
Radiochemistry
Solid-state properties

THALLIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

THORIUM

All scientific and technical aspects except mining and routine industrial uses, e.g., thoriated cathodes

THULIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

TIN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TITANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TRANSLAWRENCIUM ELEMENTS

All scientific and technical aspects

TUNGSTEN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

URANIUM

All scientific and technical aspects except mining and routine industrial applications

VANADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steel containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

XENON

Analysis, determination, and separation
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

YTTERBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

YTTRIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

ZINC

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ZIRCONIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

Part 3
INDEX

The entries in this index are to numbered paragraphs in Part 1: Scope and Arrangement or to Part 2: Extent of Interest in the Elements.

Accelerator Experimental Facilities, 54.60
Accelerators, 54.00
Accidents, 44.20
Accountability, 52.10
Activation Analysis, 40.11
Administrative Reports, 80.70
AGR-type Reactors, 77.30
Algae, 48.40
Alloys, 50.20
Analytical Chemistry, 40.10
Animals, 48.50
Antiprotonic Atoms, 64.00
Astrophysics, 56.00
Atmosphere, 44.20, 44.30, 44.60, 44.700
Atmospheric Physics, 58.00
Atomic Beams, 60.10
Atomic Explosions
See Nuclear Explosions
Atomic Physics, 58.00
Atomic Properties, 60.20, 60.50
Atomic Structure, 60.50
Atomic Theory, 60.50
Atoms, Antiprotonic, 64.00
Atoms, Hyperonic, 64.00
Aurorae, 58.10
Background Radiation, 44.50
Bacteria, 48.30
Beam Reactions, 60.10
Beam Scattering, 60.10
Beams, 60.10, 60.40
Beta-Voltaic Cells, 42.10
Bibliographies (general), 80.50
Biochemicals, 40.30, 48.10
Boiling, 42.30
Borides, 50.10
Breeder Reactors, 77.500
BWR-type Reactors, 77.100
Carbides, 50.10
Carbon, 50.30
Cardiac Pacemakers, 42.10
Cells, Cultured, 48.20
Cells, In-Vivo, 48.30, 48.40, 48.50, 48.60, 48.70
Ceramics, 50.10
Cermets, 50.10
Charge Exchange, 60.40
Chemical Effluents, 44.700
Chemical Engineering, 40.24
Chemical Plants, 40.24, 40.43, 40.45, 44.20, 44.500, 44.60, 44.700
Chemical Properties, 40.21, 40.42
Chemistry, 40.00, 80.710
Chemonuclear Reactors, 77.700
Civilian Defense, 80.10
Coal, 80.200
Clothing, 42.60
Collision Phenomena, 60.40
Computers, 80.60
Concretes, 50.30
Containers, 42.20, 42.60, 52.40
Contamination, 40.40, 42.60, 42.70, 44.00, 48.70, 77.00
Controlled Thermonuclear Research, 70.00
Corrosion, 50.00
Cosmic Radiation, 56.10
Cosmic Ray Interactions, 58.40
Cosmology, 56.60
Critical Assemblies, 77.60
Crop Disinfestation, 47.30
Cryogenic Equipment, 42.22
Cryogenics, 42.22
Cultured Cells, 48.20
Decontamination, Biological, 48.70
Decontamination, Chemical, 40.42, 77.00
Desalination, 40.14
Deuterium, 40.10, 40.20, 47.10, 48.70, 52.00, 60.20
Directories, 80.50
Disposal, 44.00, 52.20
Dissociation, 60.40
Dual-Temperature Process, 47.10
Earth, 44.30, 44.40
Earth Sciences, 44.00
Ecology, 44.300, 44.500
Economics, 79.50, 79.60, 80.20
Ecosystems, 44.30, 44.50
Elastic Scattering, 60.40
Electric Energy, 42.10, 77.00, 80.200
Electric Properties, 50.00
Electrofluid Mechanics, 62.00
Electron Beams, 60.10
Electron Sources, 60.10
Electronic Properties, 50.000
Electronic Systems, 46.30
Elementary Particle Interactions, 64.00
Elements
See Part 2. Extent of Interest in Elements
Energy Conversion, 42.10
Energy Utilization, 80.20
Engineering, 42.00, 80.740
Environment, 44.20, 44.300, 44.40, 44.60, 44.700, 77.900
Environmental Science, 44.00
Equipment, 42.20, 42.60, 52.30
Erosion, 50.00
Excitation, 60.40
Experimental Facilities, 54.60
Exposure Ages, 56.10
Fabrication, 50.00
Facilities, 42.20, 42.60
Facilities, Accelerator Experimental, 54.60
Facilities, Radioactive Effluents, 44.20
Facilities, Reactor Experimental, 77.60
Facilities, Safety, 42.70
Fallout, 44.30, 48.60, 48.70

Fallout Shelters, 42.60
Feed Materials, 40.24, 52.00
Field Theories, 76.20
Fission, 68.00, 69.10, 69.20
Fission Products, Distribution, 44.20, 44.30, 48.60, 48.70
Fission Products, Processing, 40.43
Fission Products, Use, 42.10, 47.20
Fissionable Materials, 52.00
Fluid Flow, 42.30, 77.00
Fluid Physics, 62.00
Food Cycles, 44.30
Food Processing, 47.30
Fuel Fabrication Plants
See Reactor Fuel Fabrication Plants
Fuels
See Reactor Fuels
Fungi, 48.30
Galaxies, 56.50
Gas Centrifugation, 47.10
Gaseous Diffusion, 47.10
GCFR-type Reactors, 77.50
GCR-type Reactors, 77.30
Geochronology, 44.40
Geology, 44.00
Geomagnetic Field, 58.40
Glove Boxes, 42.60
Graphite, 50.30
Gravitation, 76.30
Handling Equipment, 52.30
Handling Procedures, 52.30
Health Physics, 40.42, 44.20, 44.30, 48.00, 72.00
Heat Sources, 47.20
Heat Transfer, 42.30, 77.00
Heated Effluents, 44.60
Heavy Water, Management, 52.00
Heavy Water, Production, 47.10
Heavy Water Reactors, 77.400
Helium Hydrides, 60.20
Helium, Superfluid, 66.00
High-Energy Physics, 64.00
High-Energy Physics Instrumentation, 46.10
Hot-Atom Chemistry, 40.41
Hot Cells, 42.60
HTGR-type Reactors, 77.300
Human Cells, 48.200, 48.50
Human Tissues, 48.50
Hydrides, 50.10
Hydrology, 44.00
Hypernuclei, 64.00
Hyperonic Atoms, 64.00
Information Handling, 80.30
Inorganic Chemistry, 40.20
Instrument Components, 46.30
Instrumentation, 46.00
Instrumentation Systems, 46.40
Instruments, 46.30, 46.40
Invariance Principles, 64.30
Invertebrates, 48.50
Ion Beams, 60.10
Ion Extraction, 54.30
Ion Injection, 54.30
Ion Optics, 54.40
Ion Sources, 60.10
Ion Sources, Accelerator, 54.30
Ionization, 60.40
Ionospheric Phenomena, 58.10
Irradiation Procedures, 48.10, 48.20, 48.40, 48.50
Isotope Dilution Analysis, 40.10
Isotope Effects, 40.22
Isotope Exchange, 40.23
Isotope Production, 40.23, 40.44, 47.100
Isotope Production Reactors, 77.70
Isotope Separation, Chemical, 40.23
Isotope Separation, Industrial, 47.10
Isotope Technology, 47.00
Labeled Compounds, 40.40, 40.42
Lasers, 42.20, 47.10, 70.60
Law, 80.40
Life Sciences, 48.00
Liquid Metals, 42.30
LMFBR-type Reactors, 77.500
Low-Temperature Physics, 66.00
Magnetic Fields, Interplanetary, 56.70
Magnetic Fields, Solar, 56.40
Magnetic Properties, 50.00
Magnetofluid Mechanics, 62.00
Man, 48.50
Management, 80.50
Manuals, 80.50
Masks, 42.60
Materials, 50.00
Materials Testing, 42.40
Materials Testing or Processing Reactors, 77.70
Mathematical Physics, 76.20
Mathematics, 80.60
Matter, 68.10
Medical Supplies, 47.30, 48.300
Mesic Atoms, 60.30
Metals, 42.30, 50.20
Meteorites, 56.10
Microorganisms, 48.30
Minerals, 44.10
Mining, 44.10
Miscellaneous Reports, 80.70
Moessbauer Effect, 40.00, 50.00
Moessbauer Spectrometers, 46.10
Molecular Beams, 60.10
Molecular Physics, 60.00
Molecular Properties, 60.20
Molten Salt Reactors, 77.300, 77.400
MSBR-type Reactors, 77.400
Muonic Atoms, 60.30
Muonium, 60.30
Natural Radioactivity, 44.30, 44.500
Neutron Interactions, 68.10
Neutron Sources, 47.30
Nitrides, 50.10
Nonnuclear Energy Source Development, 80.20
Nuclear Chemistry, 40.40
Nuclear Explosions, Atmosphere Effects, 58.20
Nuclear Explosions, Civil Uses, 42.50
Nuclear Explosions, Site Surveys, 44.50
Nuclear Institutes and Programs, 80.50
Nuclear Magnetic Resonance, 50.00
Nuclear Materials Management, 52.00
Nuclear Matter, 69.20
Nuclear Models, 69.20
Nuclear Phenomena, Galactic, 56.50
Nuclear Physics, 68.00

Nuclear Power Plant Economics, 79.50
Nuclear Power Plants, 44.50, 77.00
Nuclear Properties, 68.00
Nuclear Reaction Analysis, 40.11
Nuclear Reactions, 40.10, 40.40, 64.10, 68.00, 69.10, 69.20
Nuclear Reactors, 77.00
Nuclear Spectroscopic Instruments, 46.10
Nuclear Structure, 69.20
Nuclear Theory, 69.20
Nucleate Boiling, 42.30
Nuclei, 64.00, 68.00, 69.10, 69.20
Nucleogenesis, 56.20
Nuclide Kinetics, 48.70
Nuclide Toxicology, 48.70
Oceanography, 44.00
Ores, Chemical Processing, 40.24
Ores, Geology, 44.10
Organic Chemistry, 40.20
Organisms, 48.00
Oxides, 50.10
Particle Accelerators, 54.00
Particle Interactions, 64.00
Particle Invariance, 64.30
Particle Kinetics, 58.10
Particle Symmetry, 64.30
Particle Trapping, 58.30
Pest Control, 47.30, 48.300
Phase Studies, 40.20, 40.40, 50.00
Physical Chemistry, 40.20
Physical Properties, 40.20, 40.40, 50.00
Physicochemical Properties, 40.21, 40.42
Physics, 72.00
Planetary Phenomena, 56.70
Plankton, 48.30
Plant Cells, 48.40
Plants, 48.40
Plasma Physics, 70.00
Plasma Physics, Galactic, 56.50
Plastics, 50.30
Plowshare Project, 42.50
Plutonium Production Reactors, 77.700
Polymer Production, 47.30
Positron Annihilation, 60.30
Positronium, 60.30
Power Plants, 44.60, 44.700, 77.00
Power Reactors, 77.00
Power Sources, 47.20, 80.200
Pressure Vessels, 77.00
Propulsion, 47.20, 77.80
Prospecting, 44.10, 44.400
Protective Equipment, 42.60
Protective Structures, 42.60
Publication Lists, 80.50
PWR-type Reactors, 77.20
Quantum Electrodynamics, 76.20
Quantum Field Theory, 76.20
Quantum Theory, 76.10
Quasi-Stellar Sources, 56.30
Radiation Belts, 56.70, 58.00
Radiation, Biological Effects, 48.00
Radiation Chemistry, 40.30
Radiation Detection Instruments, 46.10
Radiation Detectors, 46.10, 46.20
Radiation Doses, 46.20, 48.50, 48.60
Radiation Dosimetry, 46.20, 48.60
Radiation Effects, Biological, 48.00, 48.10, 48.20, 48.30, 48.40, 48.50, 48.60
Radiation Effects, Chemical, 40.30
Radiation Effects, Commodity Processing, 47.30
Radiation Effects, Instrument Systems, 46.30
Radiation Effects, Metallurgical, 50.00
Radiation Effects, Physical, 50.00
Radiation Effects, Solid-State, 50.00
Radiation Environments, 42.60
Radiation, Galactic, 56.50
Radiation Hazards, 44.30, 48.000
Radiation Interactions, 64.00
Radiation Monitoring, 44.30
Radiation Monitors, 46.10
Radiation Physics, 72.00
Radiation Protection Standards, 72.20
Radiation Quanta, 64.00
Radiation Scattering, 72.10
Radiation Source Calibration, 72.30
Radiation Source Standardization, 72.30
Radiation Source Technology, 47.00
Radiation Sources, Biological, External, 48.10, 48.500
Radiation Sources, Biological, Internal, 48.500, 48.60
Radiation Sources, Design, 47.30
Radiation Sources, Use in Earth Sciences, 44.40
Radiation Sources, Use in Instruments, 46.20
Radiation Surveys, 44.50
Radiation Targets, 54.60
Radiation Therapy, 48.51
Radiation Transport, 72.10
Radio Bursts, 56.40
Radio Emission, 56.70
Radio Sources, 56.30
Radioactive Decay, 40.41, 68.00, 69.10, 69.20
Radioactive Effluents, 44.20
Radioactive Materials, Biological Incorporation, 44.300, 48.60
Radioactive Materials, Chemical Properties, 40.42
Radioactive Materials, Discharge to Environment, 44.20
Radioactive Materials, Management, 52.00
Radioactive Materials, Monitoring in Environment, 44.30
Radioactive Waste, Chemical Processing, 40.43
Radioactive Waste, Disposal, 44.20, 52.00
Radioactive Waste Management, 52.00
Radioactivity Monitoring, 44.30
Radioactivity Transport, 44.30
Radiochemical Analysis, 40.13
Radiochemical Processing Plants, 40.40, 44.20, 44.50, 44.60
Radiochemistry, 40.40
Radioisotope Production, 40.44, 77.700
Radioisotopes, Analytical Use, 40.13
Radioisotopes, Distribution in Environment, 44.20, 44.30, 48.60, 48.70
Radioisotopes, Use in Biology, 48.80
Radioisotopes, Use in Earth Sciences, 44.40
Radioisotopes, Use in Industry, 47.30
Radioisotopes, Use in Power Sources, 47.20
Radiolysis, 40.30
Radiometric Analysis, 40.13
Radiometric Instruments, 46.20
Radiometric Techniques, 40.130, 44.40
Radiomimetic Effects, 48.00
Radionuclide Effects, 48.60, 48.70
Radioprotective Substances, 48.00
Radiopreservation, 47.30, 48.30
Radiosterilization, 47.30, 48.300
Radiotherapy, 48.50
Reactor Accident Liability, 77.91
Reactor Control Systems, 79.40
Reactor Engineering, 77.00

Reactor Fuel Cycle Economics, 79.60
Reactor Fuel Fabrication Plants, 44.20, 44.50, 50.00
Reactor Fuel Loading Machines, 79.20
Reactor Fuel Processing Plants, 40.45, 44.20, 44.50, 44.60
Reactor Fuels, Analysis, 40.10
Reactor Fuels, Burnup, 40.10, 77.00
Reactor Fuels, Design, 77.00
Reactor Fuels, Materials Properties, 50.00
Reactor Fuels, Reprocessing, 40.45
Reactor Licensing and Regulation, 79.70
Reactor Physics, 79.10
Reactor Technology, 77.00
Reactor Theory and Calculation, 79.10
Recoils, 40.41
Reference Books, 80.50
Refractory Materials, 50.30
Relativistic Mechanics, 76.30
Relativity Theory, 76.30
Remote-Handling Equipment, 52.30
Rod Bundles, 42.30
Safeguards, 52.10
Safety Engineering, 42.70
Scattering Theory, 64.50
Secondary Emission, 60.10
Seismology, 44.50
Shielding, 72.00, 77.00
Shielding Calculations, 72.40
Shielding Theory, 72.40
Shipping Containers, 52.40
Site Surveys, 44.50
Soil, 44.20, 44.30, 44.60, 44.700
Soil Moisture, 44.40
Solar Flares, 56.40
Solar Phenomena, 56.40
Solar System, 56.40
Solar Wind, 56.40
Solar Wind Interactions, 58.40
Solid-State Properties, 50.00
Special Materials, 52.00
Spontaneous Fission, 68.00, 69.10, 69.20
Sputtering Yields, 60.10
Standards, 72.20
Stars, 56.20
Storage, 52.20
Storage Rings, 54.50
Structures, 42.20, 42.60, 42.70, 44.20
Sun, 56.40
Sunspots, 56.40
Superconducting Equipment, 42.22
Superconductivity, 66.20
Superconductors, 42.22
Superfluid Helium, 66.10
Superfluidity, 66.10
Surface Phenomena, 50.000
Synthetic Fuels, 80.200
Testing, 42.40
Theoretical Physics, 76.00
Thermal Effluents, 44.60
Thermal Energy, 47.20
Thermionic Converters, 42.10
Thermoelectric Generators, 42.10
Thermonuclear Equipment, 70.80
Thermonuclear Physics
See Controlled Thermonuclear Research
Thermonuclear Processes, 70.80
Tissues, 48.30, 48.40, 48.50, 48.60
Toxicology, 48.70
Tracer Techniques, 40.40, 44.40, 48.80
Training Programs, 80.50
Transportation, 52.40
Tritium, 40.10, 40.22, 40.23, 40.40, 47.10, 48.70, 52.00, 60.20
Two-Phase Flow, 42.30
Ultraviolet Radiation, 48.00
Universe, 56.60
Uranium Enrichment, 47.10
Vacuum Engineering, 42.80
Van Allen Belts, 58.00
Vertebrates, 48.50
Waste Disposal, 44.20, 44.600, 44.700, 52.00
Waste Management, 52.00
Waste Processing, 40.43
Water, 44.20, 44.30, 44.60, 44.700
Well Logging, 44.40
X-Ray Analysis, 40.12, 40.13
X-Ray Sources, 56.30
Yeasts, 48.30

Appendix II

JOURNAL LIST

This list of journals supplements the listing which appeared in Volume 31, Number 1. The journals are arranged alphabetically by abbreviation.

The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579-R8, *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161, in full size or microfiche copy.

A

Aciers Spec.
Aciers Speciaux (France)

Acta Chem. Scand., Ser. A
Acta Chemica Scandinavica, Series A. Physical and Inorganic Chemistry (Denmark)
Continues in part Acta Chem. Scand.

Acta Chem. Scand., Ser. B
Acta Chemica Scandinavica, Series B. Organic Chemistry and Biochemistry (Denmark)
Continues in part Acta Chem. Scand.

Acta Med. Bulg.
Acta Medica Bulgarica (Bulgaria)

Acta Mex. Cienc. Tecnol.
Acta Mexicana de Ciencia y Tecnologia (Mexico)

Akita Daigaku Kozangakubu Chika Shigen Kenkyushisetsu Hokoku
Akita Daigaku Kozangakubu Chika Shigen Kenkyushisetsu Hokoku (Report of the Research Institute of Underground Resources Mining College, Akita University) (Japan)

Amer. J. Pub. Health, Suppl.
American Journal of Public Health, Supplement (U.S.)

Ann. Inst. Oceanogr. (Paris)
Annales de l'Institut Oceanographique (Paris) (France)

Annu. Rev. Earth Planet. Sci.
Annual Review of Earth and Planetary Sciences (U.S.)

Antiseptic
Antiseptic (India)

Arch. Microbiol.
Archives of Microbiology (West Germany)
Supersedes Arch. Mikrobiol.

Arch. Pharm. Chemi, Sci. Ed.
Archiv for Pharmaci og Chemi, Scientific Edition (Denmark)
Supersedes Dan. Tidsskr. Farm.

Argent. Electroenerg.
Argentina Electroenergetica (Argentina)

ASHRAE Trans.
ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Transactions (U.S.)

Atsuryoku Gijutsu
Atsuryoku Gijutsu (Pressure Engineering) (Japan)

Aust. J. Pharm.
Australian Journal of Pharmacy (Australia)
Supersedes Australas. J. Pharm.

Aust. Libr. J.
Australian Library Journal, The (Australia)

Avtomat. Staleplav. Proizvod.
Avtomatizatsiya Staleplavil'nogo Proizvodstva (U.S.S.R.)

B

Basic Res. Cardiol.
Basic Research in Cardiology (West Germany)
Supersedes Arch. Kreislaufforsch.

Belg.-Ned. Tijdschr. Oppervlakte Tech. Metal.
Belgisch-Nederlands Tijdschrift voor Oppervlakte Technieken van Metalen (Netherlands)

Bergbautechnik
Bergbautechnik (East Germany)

Biul., Inst. Genet. Hodowli Zwierzat
Pol. Akad. Nauk
Biuletyn, Instytut Genetyki i Hodowli Zwierzat Polskiej Akademii Nauk (Poland)
Superseded by Pr. Mater. Zootech.

Bldg. Syst. Des.
Building Systems Design (U.S.)

Bol. Cent. Nav.
Boletin del Centro Naval (Argentina)

Boundary-Layer Meteorol.
Boundary-Layer Meteorology (Netherlands)

Brit. Steel Corp., Open Rep.
British Steel Corporation, Open Report (England)

Bundesanzeiger
Bundesanzeiger (West Germany)

Bundesgesetzblatt, Teil 1
Bundesgesetzblatt, Teil 1 (West Germany)

Bundesrat - Drucksache
Bundesrat - Drucksache (West Germany)

C

Cem. Concr. Res.
Cement and Concrete Research (U.S.)

Cent. Doc. Siderugique, Circ. Inform. Tech.
Centre de Documentation Siderurgique
Circulaire d'Information Techniques (France)

Ceram. Cryst.
Ceramica y Cristal (Argentina)

Chiba Igaku Zasshi
Chiba Igaku Zasshi (Chiba Medical Journal) (Japan)
Supersedes Chiba Igakkai Zasshi

Chigaku Kenkyu
Chigaku Kenkyu (Geoscience Studies) (Japan)

Cienc. Interamer.
Ciencia Interamericana (U.S.)

Coal, Gold Base Miner. S. Afr.
Coal, Gold and Base Minerals of Southern Africa (South Africa)

Coke Chem., USSR (Engl. Transl.)
Coke and Chemistry, USSR (English Translation of Koks Khim.) (England)

Collect. Phenomena
Collective Phenomena (England)

Colliery Guardian
Colliery Guardian (England)

Colloid Polym. Sci.
Colloid and Polymer Science (West Germany)
Supersedes Kolloid-Z. Z. Polym.

COMSAT Tech. Rev.
COMSAT (Communications/Satellite Corp.) Technical Review (U.S.)

CRC Crit. Rev. Clin. Radiol. Nucl. Med.
CRC Critical Reviews in Clinical Radiology and Nuclear Medicine (U.S.)
Supersedes CRC Crit. Rev. Radiol. Sci.

CSIR (Counc. Sci. Ind. Res.) News
CSIR (Council of Scientific and Industrial Research) News (India)

Cytogenet. Cell Genet.
Cytogenetics and Cell Genetics (Switzerland)
Supersedes Cytogenetics

D

Delft Progr. Rep., Ser. D
Delft Progress Report, Series D. Architecture/Social Sciences (Netherlands)
Supersedes in part Delft Progr. Rep., Ser. A-F

Denki Gakkai Ronbunshi, B
Denki Gakkai Ronbunshi, B (The Transactions of the Institute of Electrical Engineers of Japan, B) (Japan)

Denki Gakkai Ronbunshi, C
Denki Gakkai Ronbunshi, C (The Transactions of the Institute of Electrical Engineers of Japan, C) (Japan)

Denryoku Chuo Kenkyusho Gijutsu Daiichi Kenkyusho Hokoku
Denryoku Chuo Kenkyusho Gijutsu Daiichi Kenkyusho Hokoku (Japan)

Deut. Bauz., Fachbl. Entwurf Ausfuhrung
Deutsche Bauzeitschrift, Fachblatt fuer Entwurf und Ausfuhrung (West Germany)

Diagn. Lab.
Diagnostyka Laboratoryjna (Poland)

Dokl. Biophys. (Engl. Transl.)
Doklady Biophysics (English Translation of Dokl. Akad. Nauk, Biophysics Section) (U.S.)

Dokl. Bot. Sci. (Engl. Transl.)
Doklady Botanical Sciences, (English Translation of Dokl. Akad. Nauk SSSR Botanical Sciences Sections) (U.S.)
Formerly carried as Dokl.-Bot. Sci. Sect. (Engl. Transl.)

Dornier-Post (Engl. Ed.)
Dornier-Post (English Edition) (West Germany)

E

Earth Miner. Sci.
Earth and Mineral Sciences (U.S.)

Ekspress-Inform., Montazh Oborudovaniya Teplovykh Elektrosta.
Ekspress-Informatsiya, Montazh Oborudovaniya na Teplovykh Elektrostantsiyakh (U.S.S.R.)

Ekspress-Inform., Stroit. Tepl. Elektrosta.
Ekspress-Informatsiya, Stroitel'stvo Teplovykh Elektrostantsii (U.S.S.R.)

Elec. App.
Electrical Apparatus with Electric Heat (Supplemental inserts titled Electric Heat appear in odd-numbered months) (U.S.)

Electrodeposition Surface Treat.
Electrodeposition and Surface Treatment (Switzerland)

Energies
Energies (France)

Energ. Stroit. Rubezhom
Energeticheskoe Stroitel'stvo za Rubezhom (Supplement to Energ. Stroit.) (U.S.S.R.)

Energy Rev.
Energy Review (U.S.)

Energy Syst. Policy
Energy Systems and Policy (U.S.)

Eng. Times (Calcutta)
Engineering Times (Calcutta) (India)

Erfahrungsheilkunde
Erfahrungsheilkunde (West Germany)

Eulep Newslett.
Eulep (European Late Effects Project Group) Newsletter (Belgium)

Eur. J. Med. Chem. - Chim. Ther.
European Journal of Medicinal Chemistry - Chimica Therapeutica (France)
Supersedes Chim. Ther.

Eur. Plast. News
European Plastics News (England)
Supersedes Europlast. Mon.

F

Faraday Discuss. Chem. Soc.
Faraday Discussions of the Chemical Society (England)
Supersedes Discuss. Faraday Soc.

Faraday Symp. Chem. Soc.
Faraday Symposia of the Chemical Society (England)

Felsmech. Ingenieurgeol.
Felsmechanik und Ingenieurgeologie (Austria)
Superseded by Rock Mech.

Finn. Chem. Lett.
Finnish Chemical Letters (Finland)
Supersedes Suom. Kem., B and supersedes in part Suom. Kemistiseuran Tiedon.

Finomech.-Mikrotech.
Finommechanika-Mikrotechnika (Hungary)
Supersedes Finommechanik

Fish. Bull.
Fishery Bulletin (U.S.)

Freiberg. Forschungsh., A
Freiberger Forschungshefte, A (East Germany)

Fundam. Cosmic Phys.
Fundamentals of Cosmic Physics (England)

G

Galvano-Organo
Galvano-Organo (France)
Supersedes Galvano

Ganita
Ganita (India)

Gas Oil Power
Gas and Oil Power (England)

Gas World
Gas World (England)

Gaz. Cukrow.
Gazeta Cukrownicza (Poland)

Geochimica (Engl. Transl.)
Geochimica (English Translation of Ti Ch'iu Hua-Hsueh) (U.S.)

Geophys. Res. Lett.
Geophysical Research Letters (U.S.)
Supersedes Letters Section of J. Geophys. Res.

Geotimes
Geotimes (U.S.)

Gesetz Verordnungsbl. Land Hessen, Teil 1
Gesetz und Verordungsblatt fuer das Land Hessen, Teil 1 (West Germany)

GKSS-Inform.
GKSS-Informationen (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H. (West Germany)

Glas. Prir. Muz. Beogradu, Ser. A
Glasnik Prirodnjackog Muzeja u Beogradu, Serija A. Mineralogija, Geologija, Paleontologija (Yugoslavia)

Gold Bull.
Gold Bulletin (South Africa)

Gynecologie
Gynecologie (France)
Supersedes Gynecol. Prat.

H

Heat. Air Cond. J.
Heating and Air Conditioning Journal, The (England)
Incorporating The Steam and Heating Engineer, The Steam Engineer, Heating and The Industrial Heating Engineering

Histochemistry
Histochemistry (West Germany)
Supersedes Histochemie

Hydrocarbon Process.
Hydrocarbon Processing (U.S.)

Hydrol. Sci. Bull.
Hydrological Sciences Bulletin/Bulletin des Sciences Hydrologiques (England)

I

IEEE Trans. Acoust., Speech, Signal Process.
IEEE (Institute of Electrical and Electronics Engineers) Transactions on Acoustics, Speech and Signal Processing (U.S.)
Supersedes IEEE Trans. Audio Electroacoust.

IEEE Trans. Circuits Syst.
IEEE (Institute of Electrical and Electronics Engineers) Transactions on Circuits and Systems (U.S.)
Supersedes IEEE Trans. Circuit Theory

IEEE Trans. Ind. Appl.
IEEE (Institue of Electrical and Electronics Engineers) Transactions on Industry Applications (U.S.)
Supersedes IEEE Trans. Ind. Gen. Appl.

IEEE Trans. Parts, Hybrids, Packag.
IEEE (Institute of Electrical and Electronics Engineers) Transactions on Parts, Hybrids, and Packaging (U.S.)
Supersedes IEEE Trans. Parts, Mater., Packag.

IEEE Trans. Plasma Sci.
IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (U.S.)

Impuls
Impuls. Zeitschrift des Industriezweiges Automatisierungsgeraete (East Germany)

Incompat. Newslett.
Incompatibility Newsletter (Netherlands)

Ind. Safety Chron.
Industrial Safety Chronicle (India)

Ing. Ambientale
Ingegneria Ambientale (Italy)

Ingenieur (The Hague)
Ingenieur (The Hague) (Netherlands)

Ing. Ind.
Ingenieria e Industria (Argentina)

Inst. Mining Met., Trans., Sect. A
Institution of Mining and Metallurgy, Transactions, Section A. Mining Industry (England)

Int. Biodeterior. Bull.
International Biodeterioration Bulletin (England)

Interavia
Interavia (Switzerland)

Int. J. Earthquake Eng. Struct. Dyn.
International Journal of Earthquake Engineering and Structural Dynamics (England)

Int. J. Radiat. Eng.
International Journal of Radiation Engineering (Israel)

Ironmaking Steelmaking
Ironmaking and Steelmaking (England)
Supersedes J. Iron Steel Inst. (London)

Iron Steel Int.
Iron and Steel International (England)
Supersedes Iron Steel (London)

IRS Kurz-Inform., Reihe A
IRS Kurz-Information, Reihe A (West Germany)

IRS Kurz-Inform., Reihe D
IRS Kurz-Information, Reihe D (West Germany)

Itogi Nauki Tekh., Metalloved. Term. Obrab.
Itogi Nauki i Tekhniki, Metallovedenie i Termicheskaya Obrabotka (U.S.S.R.)

Izv. Inst. Biokhim., Bulg. Akad. Nauk.
Izvestiya na Instituta po Biokhimiya, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Inst. Fiziol. Rast., Bulg. Akad. Nauk.
Izvestiya na Instituta po Fiziologiya na Rasteniyata, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Inst. Srav. Patol. Shivotn., Bulg. Akad. Nauk.
Izvestiya na Instituta po Sravnitelna Patologiya na Zhivotnite, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Tsent. Khelmintol. Lab., Bulg. Akad. Nauk.
Izvestiya na Tsentralnata Khelmintologichna Laboratoriya, Bulgarska Kademiya na Naukite (Bulgaria)

J

J. Bryol.
Journal of Bryology (England)
Continues Trans. Brit. Bryol. Soc.

J. Calif. Dent. Ass.
Journal of the California Dental Association (U.S.)
Supersedes J. Calif. State Dent. Ass.

J. Comp. Physiol.
Journal of Comparative Physiology (West Germany)
Supersedes Z. Vergl. Physiol.

J. Electron. Mater.
Journal of Electronic Materials (U.S.)

J. Eng. Mater. Technol.
Journal of Engineering Materials and Technology (U.S.)

J. Fluids Eng.
Journal of Fluids Engineering (U.S.)
Supersedes in part J. Basic Eng.

J. Geotech. Eng. Div., Amer. Soc. Civil Eng.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers (U.S.)

J. Interdisciplinary Cycle Res.
Journal of Interdisciplinary Cycle Research (Netherlands)

J. Jiwaji Univ.
Journal of Jiwaji University (India)

J. Korean Soc. Mech. Eng.
Journal of the Korean Society of Mechanical Engineers (South Korea)

J. Mechanochem. Cell Motility
Journal of Mechanochemistry and Cell Motility (England)

J. Phys. (Paris), Lett.
Journal de Physique (Paris), Lettres (France)

J. Radiat. Curing
Journal of Radiation Curing (U.S.)

J. Speech Hear. Disord.
Journal of Speech and Hearing Disorders (U.S.)

J. Steroid Biochem.
Journal of Steroid Biochemistry (England)

J. Struct. Mech.
Journal of Structural Mechanics (U.S.)

K

Kaelte (Hamburg)
Kaelte (Hamburg) (West Germany)

Kagawa Daigaku Nogakubu Gakujutsu Hokoku
Kagawa Daigaku Nogakubu Gakujutsu Hokoku (Technical Bulletin of Faculty of Agriculture, Kagawa University) (Japan)

Kawasaki Seitetsu Giho
Kawasaki Seitetsu Giho (Kawasaki Steelmaking Technical Report) (Japan)

Kexue Tongbao (Scientia) (Engl. Transl.)
Kexue Tongbao (Scientia) (English Translation of K'o Hsueh T'ung Pao) (U.S.)

Khim. Plazmy
Khimiya Plazmy (U.S.S.R.)

Kogai
Kogai (Pollution Control) (Japan)

Koks Khim.
Koks i Khimiya (U.S.S.R.)
Issued in English translation as Coke Chem., USSR

Koks, Smola, Gaz
Koks, Smola, Gaz (Poland)

Koolaj Foldgaz
Koolaj es Foldgaz (Hungary)

Kotsu Taisha
Kotsu Taisha (Bone Metabolism) (Japan)

K'un Ch'ung Hsueh Pao
K'un Ch'ung Hsueh Pao (Acta Entomologica Sinica) (China)

Kyoto Furitsu Daigaku Gakujutsu Hokoku (Rigaku, Seikatsu Kagaku)
Kyoto Furitsu Daigaku Gakujutsu Hokoku (Rigaku, Seikatsu Kagaku) (Scientific Reports of the Kyoto Prefectural University (Natural Science and Life Science)) (Japan)

L

Leitz-Mitt. Wiss. Tech.
Leitz-Mitteilungen fuer Wissenschaft und Technik (West Germany)

M

Mag. Concr. Res.
Magazine of Concrete Research (England)

Mar. Chem. (Amsterdam)
Marine Chemistry (Amsterdam) (Netherlands)

Mater. Performance
Materials Performance (U.S.)
Supersedes Mater. Protect. Performance

Med. Biol. (Helsinki)
Medical Biology (Helsinki) (Finland)
Supersedes Ann. Med. Exp. Biol. Fenn. (Helsinki)

Med. Contact
Medisch Contact (Netherlands)

Metallogr. Rev.
Metallographic Review (U.S.)

Metalurgiya (Sofia)
Metalurgiya (Sofia) (Bulgaria)

Mezhdunar. Sel'skokhoz. Zh.
Mezhdunarodnyi Sel'skokhozyaistvennyi Zhurnal (U.S.S.R.)

Microsc. Acta
Microscopica Acta (West Germany)
Supersedes Z. Wiss. Mikrosk.

Mitt. Brennstoffinstit. Freiberg
Mitteilungen des Brennstoffinstitutes Freiberg (East Germany)

Mol. Biol. Rep.
Molecular Biology Reports (Netherlands)

Mol. Cell. Biochem.
Molecular and Cellular Biochemistry (Netherlands)
Supersedes Enzymologia

Monogr. Neoplast. Dis. Various Sites
Monographs on Neoplastic Disease at Various Sites (Scotland)

Mt. Sinai J. Med.
Mount Sinai Journal of Medicine, The (U.S.)

N

Nat. Saf. (S. Afr.)
National Safety (South Africa)

Natur. Resour. Lawyer
Natural Resources Lawyer (U.S.)

Nauch. Tr., Perm. Politekh. Inst.
Nauchnye Trudy, Permskii Politekhnicheskii Institut (U.S.S.R.)

Nauch. Tr., Vissh Selskostop. Inst., Sofia, Zootekh. Fak.
Nauchni Trudove, Vissh Selskostopanski Institut Georgi Dimitrov, Sofia, Zootekhnicheski Fakultet (Bulgaria)

Nauch. Tr., Vses. Nauch.-Issled. Proekt. Inst. Tugoplavkikh Met. Tverd. Splavov
Nauchnye Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii i Proektnyi Institut Tugoplavkikh Metallov i Tverdykh Splavov (U.S.S.R.)

NCRR Bull.
NCRR (National Center for Resource Recovery, Inc.) Bulletin (U.S.)

Ned. Mil. Geneesk. Tijdschr.
Nederlands Militair Geneeskundig Tijdschrift (Netherlands)

Neth. J. Plant Pathol.
Netherlands Journal of Plant Pathology (Netherlands)

Niedersaechsisches Ministerialbl.
Niedersaechsisches Ministerialblatt (West Germany)

Nippon Geka Gakkai Zasshi
Nippon Geka Gakkai Zasshi (Japan)

Nippon Zosen Kenkyu Kyokai Hokoku
Nippon Zosen Kenkyu Kyokai Hokoku (Japan)

Nogyo Doboku Shikenjo Hokoku
Nogyo Doboku Shikenjo Hokoku (Bulletin of the Agricultural Engineering Research Station) (Japan)

Norsk Lovtidend
Norsk Lovtidend (Norway)

Nor. Tannlaegeforen. Tid.
Norske Tannlaegeforenings Tidende (Norway)

Nov. Zhizni, Nauke, Tekh., Ser. Kosmonavt., Astron.
Novoe v Zhizni, Nauke, Tekhnike, Seriya Kosmonavtika, Astronomiya (U.S.S.R.)

O

Obrab. Metal. Davleniem Mashinostr.
Obrabotka Metallov Davleniem v Mashinostroenii (Ukrainian S.S.R.)

Ocean Manage.
Ocean Management (Netherlands)

Osaka Furitsu Kogyo Gijutsu Kenkyusho Hokoku
Osaka Furitsu Kogyo Gijutsu Kenkyusho Hokoku (Reports of Osaka Prefectural Industrial Research Institute) (Japan)
Supersedes Osaka Furitsu Kogyo Shoreikan Hokoku

P

Paint Varn. Prod.
Paint and Varnish Production (U.S.)

Phys. Condens. Matter
Physics of Condensed Matter (West Germany)
Supersedes Phys. Kondens. Mater.

Phys. News (India)
Physics News. Bulletin of the Indian Physics Association (India)

Phys. Quantum Electron.
Physics of Quantum Electronics (U.S.)

Pol. J. Soil Sci.
Polish Journal of Soil Science (Poland)

Postepy Tech. Jad.
Postepy Techniki Jadrowej (Poland)

Praktiker
Praktiker (Supplement to Schweissen und Schneiden (West Germany)

Prepr. Ser., Inst. Math., Univ. Oslo
Preprint Series, Institute of Mathematics, University of Oslo (Norway)

Prikl. Yadern. Spektrosk.
Prikladnaya Yadernaya Spektroskopiya (U.S.S.R.)

Probl. Fiz. Atmos.
Problemy Fiziki Atmosfery (U.S.S.R.)

Probl. Kosm. Fiz.
Problemy Kosmicheskoi Fiziki (Ukrainian S.S.R.)

Probl. Tech. Med.
Problemy Techniki w Medycynie (Poland)

Process Eng.
Process Engineering Incorporating Chemical and Process Engineering (England)

Process Technol. Int.
Process Technology International (England)
Absorbed by Chem. Process (London)

Proc. Finn. Dent. Soc.
Proceedings of the Finnish Dental Society (Finland)

Proc. Radioisotope Soc. Philipp.
Proceedings of the Radioisotope Society of the Philippines (Philippines)

Proc. Roy. Soc. Queensl.
Proceedings of the Royal Society of Queensland (Australia)

Prostaglandins
Prostaglandins (U.S.)

Przegl. Gorn.
Przeglad Gorniczy (Poland)

Przegl. Wlok.
Przeglad Wlokienniczy (Poland)

Publ. Energ.
Publicacion sobre Energia (Argentina)

Q

Quintessenz
Quintessenz (West Germany)

R

Radio Electron.
Radio Electronica (Netherlands)

Refrig. Air Cond.
Refrigeration and Air Conditioning (England)

Rend. Ist. Lombardo Sci. Lett., B
Rendiconti dell'Istituto Lombardo di Scienze e Lettere, B. Scienze Biologiche e Mediche (Italy)

Rentgenovskaya Difraktometriya Monokrist., Ser.
Metody Rentgenovskogo Anal.
Rentgenovskaya Difraktometriya Monokristallov, Seriya Metody Rentgenovskogo Analiza (U.S.S.R.)

Rev. Ass. Med. Brasil.
Revista da Associacao Medica Brasileira (Brazil)

Rev. Gen. Tech.
Revue Generale des Techniques (France)
Formed by merger of Genie Civil; Met. Constr. Mec. and Travaux Publics et Enterprises

S

Saigai Igaku
Saigai Igaku (Journal of Accidental Medicine) (Japan)

Sb. Geol. Ved, Loziskova Geol.
Sbornik Geologickych Ved, Loziskova Geologie (Czechoslovakia)

Sb. Nauch. Tr., Erevan. Politekh. Inst.
Sbornik Nauchnykh Trudov, Erevanskii Politekhnicheskii Institut (Armenian S.S.R.)

Sb. Rab., Leningrad. Vet. Inst.
Sbornik Rabot, Leningradskii Veterinarnyi Institut (U.S.S.R.)

Sb. Tr., Nauch.-Issled. Onkol. Inst., Sofia
Sbornik Trudove, Nauchno-Izsledovatelski Onkologichen Institut, Sofia (Bulgaria)

Sb. Vys. Sk. Chem.-Technol. Praze, Anorg.
Chem. Technol.
Sbornik Vysoke Skoly Chemicko-Technologicke v Praze, Anorganicka Chemie a Technologie (Czechoslovakia)

Scand. J. Rheumatol.
Scandinavian Journal of Rheumatology (Sweden)
Supersedes Acta Rheumatol. Scand.

Shika Kiso Igakukai Zasshi
Shika Kiso Igakukai Zasshi (Japan)

Shu-hsueh Hsueh-pao
Shu-hsueh Hsueh-pao (Acta Mathematica Sinica) (China)

Sovrem. Probl. Radiobiol.
Sovremennye Problemy Radiobiologii (U.S.S.R.)

Sov. Sci. Rev.
Soviet Science Review (England)

Stochastics
Stochastics (England)

Svoistva At. Yader
Svoistva Atomnykh Yader (U.S.S.R.)

T

Technomet
Technomet (India)

Tex. Law Rev.
Texas Law Review (U.S.)

Text.-Prax.
Textil-Praxis (West Germany)

Texture
Texture (England)

Therapeutique
Therapeutique (France)
Supersedes Sem. Ther.

Ti-li Chih-shih
Ti-li Chih-shih (Geographical Knowledge) (China)

Tohoku Daigaku Kosoku Rikigaku Kenkyusho Hokoku
Tohoku Daigaku Kosoku Rikigaku Kenkyusho Hokoku (Memoirs of the Inst. of High Speed Mechanics, Tohoku University) (Japan)

Trade Ind.
Trade and Industry (England)

Transm. Distrib.
Transmission and Distribution (U.S.)

Transp. Eng. J.
Transportation Engineering Journal of ASCE, Poceedings of the American Society of Civil Engineers (U.S.)

Transplant. Proc., Suppl.
Transplantation Proceedings, Supplement (U.S.)

Trans. Roy. Soc. S. Afr.
Transaction of the Royal Society of South Africa (South Africa)

Tr. Lab. Elektromagn. Polei Radiochastot Inst. Gig. Tr. Prof. Zabol. Akad. Med. Nauk SSSR
Trudy Laboratorii Elektromagnitnykh Polei Radiochastot Instituta Gigieny Truda i Professional'nykh Zabolevanii Akademii Meditsinskikh Nauk SSSR (U.S.S.R.)

Tr. Leningrad. Sanit.-Gig. Med. Inst.
Trudy Leningradskogo Sanitarno-Gigienicheskogo Meditsinskogo Instituta (U.S.S.R.)

Tr., Tsent. Nauch.-Issled. Inst. Tekhnol. Mashinostr.
Trudy, Tsentral'yi Nauchno-Issledovatel'skii Institut Tekhnologii i Mashinostroeniya (U.S.S.R.)

Tr. Tyumenskogo Ind. Inst.
Trudy Tyumenskogo Industrial'nogo Instituta (U.S.S.R.)

Tr. Ural. Nauch.-Issled. Inst. Chern. Metal.
Trudy Ural'skogo Nauchno-Issledovatel'skogo Instituta Chernykh Metallov (U.S.S.R.)

Tr., Vses. Nauch.-Issled. Inst. Podzemn. Gazif. Uglei
Trudy Vsesoyuznyi Nauchno-Issledovatel'skii Institut Podzemnoi Gazifikatsii Uglei (U.S.S.R.)

U

Uch. Zap., Kabardino-Balkar. Gos. Univ.
Uchenye Zapiski, Kabardino-Balkarskii Gosudarstvennyi Universitet (U.S.S.R.)

Uch. Zap., Mord. Gos. Univ.
Uchenye Zapiski, Mordovskii Gosudarstvennyi Universitet (U.S.S.R.)

Umwelt (Inform. Bundesmin. Inn.)
Umwelt (Informationen des Bundesministers des Innern zur Umweltplanung und zum Umweltschutz) (West Germany)

Umweltschutz - Staedterinigung
Umweltschutz - Staedtereinigung (Austria)

Underwater Inform. Bull.
Underwater Information Bulletin (England)
Supersedes Underwater J.

V

Veda Tech. SSSR
Veda a Technika v SSSR

Voenna Tekh.
Voenna Tekhnika (Bulgaria)

Vop. Kibern.
Voprosy Kibernetiki (Uzbek S.S.R.)

W

Waste Age
Waste Age (U.S.)

Y

Yakhak Hoeji
Yakhak Hoeji (Journal of the Pharmaceutical Society of Korea) (South Korea)

Z

Z. Ausl. Oeff. Oeffentliches Recht Voelkerrecht
Zeitschrift fuer Auslaendisches Oeffentliches Recht und Voelkerrecht (West Germany)

Z. Hautkrankheiten
Zeitschrift fuer Hautkrankheiten (West Germany)
Supersedes Z. Haut- Geschlechtskr.

Zh. Gig., Epidemiol., Mikrobiol. Immunol.
Zhurnal Gigieny, Epidemiologii, Mikrobiologii i Immunologii (Czechoslovakia)

☆U. S. GOVERNMENT PRINTING OFFICE: 1975—640-089/26

COMPLETE OR PARTIAL COLLECTIONS OF ERDA REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atômica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Karlsruhe, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830
OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

U.S.MAIL

GE AND FEES PAID
RNMENT PRINTING OFFICE

U.S.MAIL

XEROX UNIVERSITY MICROFILMS 1
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

Announcing the publication of a new bibliography

COAL PROCESSING: Gasification, Liquefaction, and Desulfurization (TID-3349)

This 757-page bibliography contains 7441 references, covering a period of 40 years, to scientific and technical information on coal gasification, liquefaction, and desulfurization research to produce clean-burning fuels. References are arranged chronologically in subject categories, such as Processing, By-Products, and Waste Management. A glossary of various processes used in converting and purifying coal is included. Also included are personal author, subject, and report number indexes. The computer-selected references were compiled and indexed by the U. S. Atomic Energy Commission's Office of Information Services, Technical Information Center (published in October 1974).

TID-3349 is available from
National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22161

Paper Copy: $13.60

Microfiche: $2.25 (domestic)
$3.75 (foreign)